THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 60 — Thursday, April 13, 1939 — No. 1182

PUBLISHED WEEKLY

Subscription Terms : 17s. 6d. per annum.
Foreign and Colonial : 20s. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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The International Congress

Elsewhere in this issue are given details of the programme which has been arranged for the enlightenment and entertainment of the overseas delegates and members of the Institute of British Foundrymen during the forthcoming International Congress in London. The work which this has entailed has been extremely arduous, and everybody is hoping that the international situation will straighten out itself during the next few days, in order that the foundrymen can again demonstrate that science is devoid of political boundaries. The main features of the Congress, which is to be held from June 12 to 17 in London, are the official opening by the Rt. Hon. the Lord Mayor of London (Sir Frank Bowater, Kt.); Mr. Lake's Presidential Address; the delivery of the fourth Edward Williams Lecture by Professor W. L. Bragg, F.R.S.; the Government Reception, when the guests will be received by Lord and Lady Runciman; the Congress Banquet at the Dorchester Hotel, at which function the Rt. Hon. Oliver Stanley, President of the Board of Trade, will be the principal guest; the reception by Mr. W. B. Lake, J.P., and Mrs. Lake at the Dorchester Hotel; and the trip up the River Thames. For the ladies there are visits to the House of Commons, the Barbers' Hall, Whipsnade, a large departmental stores and various factories. The works visits in the London area, considering the armaments ban imposed by Government departments, cover a particularly wide field and embrace a large motor-vehicle foundry, a radiator foundry, a malleable chain foundry, a bell foundry, a mechanised non-ferrous foundry, a mechanised mangle factory, a stove-grate foundry, an electric-cooker works and a refrigerator foundry.

About forty technical Papers and Reports are to be submitted, and it would be difficult to find a phase of foundry work not covered. There are numerous Papers dealing with sands and refractories; these should be of a really practical and helpful character. The practical man will appreciate studies of gating and the making of large steelworks' castings. Fundamental knowledge will be recorded in "The Atomic Pattern of Metals" by Professor Bragg, who possesses a special gift for making the most abstruse physical research readily understandable by the ordinary technician. Working data are to be disclosed in a Paper on the thermal conductivities of some of the newer irons. Two Papers are scheduled to be presented on centrifugal casting, whilst light alloys are covered by six contributions. Malleable cast iron is dealt with by two authors and steel castings form the subject of a joint session with the Iron and Steel Institute, when six Papers are to receive consideration. Heavy non-ferrous work is covered by a Report from the appropriate sub-committee of the Institute, supplemented by a Paper on copper castings. Other subjects included in the programme are cupola practice, cutting tools for cast iron, foundry education, Dominion industrial legislation, inverse segregation, inherent properties of pig-iron, and the work of the Institute's Technical Committee. In addition there are still one or two Papers, the titles of which are not yet available.

All the above represents the work of the actual Congress, but for those who can spare the time there is, in addition, the most comprehensive inspection of British foundry establishments that has ever been planned, and those who can participate can indeed count themselves fortunate. This is well recognised, as already more than one educational authority is planning to take parties of students on the tour. This should induce British foundry proprietors to consider seriously whether they can afford not to be represented on this occasion, because if a similar tour were arranged for America or any other great industrial country at the same cost, they would not hesitate. We assert without fear of contradiction that the foundries to be inspected, both in London and the Provinces, are equally well equipped and intelligently managed as any in the whole world. Moreover, many have a commendable measure of elasticity often absent in similar plants abroad. It is truthful to state that there has been a complete metamorphosis of British foundry practice since the last International Congress in London was held in 1929.

An invitation is extended to the foundrymen of the world to participate, and no matter what their nationality a cordial welcome awaits them. The sole object of the Congress is that by means of joint discussion of their mutual problems, foundrymen will be in a better position to manufacture a superior article at a lower prime cost, whilst endeavouring to create a better standard of living for all engaged in the industry. Everything is being done by the hosts to make it an outstanding success, and it now requires the wholehearted participation by their colleagues at home and overseas.

Book Review

The Principles of Metallographic Laboratory Practice. By George L. Kehl, B.S., M.S. Published by the McGraw-Hill Publishing Company, Limited, Aldwych House, London, W.C.2. Price 21s.

With this volume, the author has met a very definite need for a text book of fundamental principles involved in metallographic laboratory practice, and has produced an excellent book bridging the gap between theoretical physical metallurgy and its practical application in the laboratory. As the title implies, the book is primarily a treatment of laboratory principles, but in many instances the statement of principles has been supplemented by explicit recommendations. The value of the book is also considerably enhanced by illustrations of the results of proper and improper techniques and the effects of correct and incorrect procedures.

The first chapter deals with the preparation of specimens for microscopic examination. Besides giving details of polishing procedure, the author also deals at considerable length with the mounting of small specimens. Full instructions are given for the mounting of samples in different media, and, whilst in the case of plastic materials, which cannot be compounded in a metallurgical laboratory, U.S.A. trade names are given, they may be matched by corresponding products procurable in this country. Besides giving particulars of procedure for the mounting of specimens in plastic materials requiring pressure moulding, particulars are given for the mounting of samples in Bakelite resinoid No. BR.0014,* a viscous liquid.

The second chapter deals comprehensively with the etching of specimens for microscopic examination, and is augmented by nine tables giving particulars of recommended etching reagents for practically all commercial alloys. These tables are to be found in the appendix.

The third chapter deals with metallurgical microscopes and photomicrography. Although short, it is particularly comprehensive and understandable. It is illustrated with numerous photomicrographs showing the effect of change in numerical aperture and in aperture diaphragm, the difference between bright-field illumination and dark-field illumination, and the like. Working details are given for the adjustment of the optical system necessary for the production of high-grade photomicrographs.

Chapter IV is devoted to the principles of photography and contains sections dealing with photographic plates and films, development of plates, choice of printing papers, dark room technique, etc.

The microscopic examination of metals is dealt with in Chapter V—the only chapter in which the present volume is to be found wanting in any way. The photographic recording of macrostructures calls for great skill in illumination, and it is a pity that the author has dismissed that side of the subject in a few lines. This book, however, may well call for a second edition and, if it does, it is to be hoped that the omission will be rectified.

A chapter devoted to special metallurgical tests gives particulars for determining the austenitic grain size in steel and non-ferrous metals and alloys, and methods of grain size designation as well as particulars of the McQuaid-Ehn test and the Shephard Penetration-Fracture test. The Olsen and the Erichsen cupping testers are also described.

Other chapters deal adequately with hardness testing, pyrometry and pyrometric practice and thermal analysis. The appendix contains a number of extremely useful tables.

J. Ferdinand Kayser.

* A similar material procurable in England is Bakelite Cement N.P.A.—treatment approximately 15 hours at 85 deg. C.; bake till hard at 100 deg. C.—Reviewer.

Notes from the Branches

EAST MIDLANDS

The East Midlands Branch of the Institute of British Foundrymen held their annual general meeting at Loughborough College on March 25. Mr. B. Gale (hon. secretary), presenting his report, said once again he was in the happy position to record a very successful year and the continuance of progress in the Branch. The attendances at meetings showed an average of 66, and in addition they had a works visit during mid-week which attracted 25 members. One of the ordinary meetings was held in Rugby and was preceded by a visit to the British Thomson-Houston Works. He wished to record the thanks of the Branch to the directors and staffs of Midland Electric Manufacturing Company, Limited, and the British Thomson-Houston Company for their hospitality and courtesy on the two works visits. They were also indebted to Mr. P. A. Russell and Mr. G. L. Harbach, Mr. H. E. Blayden, Mr. P. C. Bleakman and Mr. C. D. Pollard, who presented Papers during the session, and in particular to Mr. Pollard, who presented a second Paper in the unfortunate absence through illness of Mr. A. Tipper. The annual dinner and dance at Loughborough was a successful function and attracted a record attendance of 139 members, ladies and guests.

The membership figures, after adjustments, showed a net increase of 18 since the last annual meeting. During the year 27 members had been enrolled by or transferred to the Branch, and nine members had been lost. Three had died during the year—Mr. S. A. Gimson, Mr. C. H. Smith and Mr. W. T. Styles. Their present membership consisted of one hon. life member, four subscribing firms, 65 members, 100 associate members and five associates. The figures included the Lincoln Section, which was showing good progress and now had 22 members, an increase of seven since the last annual meeting.

Financially, the Branch had had a successful year, and the subscriptions were on a higher plane, due to their increased membership. They had not, however, created a record in subscription income *pro rata* to membership figures, the arrears at December 31, 1938, being rather higher than they should be.

At the last Conference the Branch was honoured by the presentation of the Oliver Stubbs Medal to their Vice-President, Mr. S. E. Dawson. Mr. Bunting was also elected a member of Council. The Branch was also well served on General Council Committees and Technical Committees.

The adoption of the report was moved by Mr. Dawson, seconded by Mr. Butters.

The following officers for the ensuing year were then elected:—*President*, Mr. R. H. Buckland; *Senior Vice-President*, Mr. S. E. Dawson; *Junior Vice-President*, Mr. H. J. Beck; *Honorary Secretary*, Mr. B. Gale; *Honorary Auditors*, Mr. W. H. Smith and Mr. F. Butters; *Representatives on Technical Committee*, Mr. P. A. Russell and Mr. A. E. Peace; *Members of Branch Council*, Mr. F. G. Butters, Mr. S. A. Horton, Mr. J. F. Measures and (for one year) Mr. J. C. Hallamore.

Mr. R. Spriggs was cordially thanked for his work as President during the past year.

A new professional association has been established as the Institution of Factory Managers, under the Presidency of Sir James Fildes, M.P., J.P. The secretary-treasurer, who has largely been responsible for its creation, is Mr. L. M. Angus-Butterworth, of Ashton New Hall, Ashton-on-Mersey, Cheshire, from whom full particulars are available. There are two grades of membership, fellowship and associateship, the subscriptions being £2 2s. and £1 1s. respectively. At the end of 1939 entrance fees will be instituted.

Random Shots

It was a pity that such a gloriously fine Easter should have been overclouded with disturbing international events, for during the week-end another small country came tragically into the news. Hitherto, the average Englishman's acquaintance with Albania was of the scantiest, in some cases confined to a knowledge of the name of the king, and that only because it conjured up a memory of a well-known poster slogan, which read "Zog it off." Nor were there many who could state more than one or two towns (inclusive of its capital) until recent events compelled the newspapers to print a map every time the country was mentioned. Even then it is difficult to memorise such peculiar names; Durazzo, perhaps, is not so bad, because it has the sound of a washable distemper and such like words that are on the lips of every handy-man during Spring renovation time. A little farther up the map, but in Jugoslavia, a hasty glance reveals that Metro-Vic must have a branch in those parts . . . but closer examination proves the name of the town to be, in actuality, Metkovic! Only by such methods of association of ideas can the poor Englishman hope to memorise these foreign names as he goes about Central Europe (Poland especially!) on foundry business.

* * *

The monkey puzzle is still bringing inquiries from as far afield as Ireland and the U.S.A. It is obvious that such problems are peculiarly suited in some unaccountable way to the mind of the foundryman. Indeed, there have been such clamourings for more doses of the same medicine that "Marksman" would be pleased to present any other problem that anyone has to offer. In the meantime here is a simple little teaser, not bad enough to prevent a night's sleep, but just difficult enough to cause indigestion after the Sunday roast beef and Yorkshire pud. The weekly output of a manufacturer of malleable chain links runs into six figures. If he were to produce four times the number, however, the figures would be the same, but in the reverse order. The problem is to determine his weekly output.

* * *

The Editor is feeling jubilant. He says that by moving his home to another suburb of London he is going to save twelve and a half days a year in travelling time! One wonders what he is going to do with them! It is reminiscent of the story of the late Mr. Oliver Stubbs who was taken up to the top of the Woolworth building in New York by the late Mr. Cole Estep. Rejecting one lift because it stopped at several floors *en route*, Mr. Estep explained that by going up in the express lift they would save one hundred seconds. Up shot the lift to the top floor, and out stepped Mr. Stubbs duly impressed.

"And now, Cole," said he with a twinkle in his eye, "what are we going to do with those hundred seconds we have saved?"

* * *

Any foreman after any works' "do": "Excushe me, but is thish house number 6?"

"No," replied the passer-by. "It is number 66."

"Hurray! Then I'm shober after all!"

* * *

Lot No. V from the Barrington Hooper Collection:—

"In the United States," wrote Tommy, "people are put to death by elocution."

All of us are always going to do better tomorrow, and we would, too, if only we started today.

"Marksman."

The International Congress in London

DETAILS OF THE FINAL PROGRAMME

Arrangements for the 1939 International Foundry Congress, to be held in London from June 12 to 17, are now almost complete, and official recognition has been granted to the Congress by His Majesty's Government, at whose invitation a Reception will be held on Tuesday, June 13.

The official opening of the Congress by the Rt. Hon. the Lord Mayor of London, Sir Frank Bowater, Kt., will take place on the morning of Tuesday, June 13, at the Dorchester Hotel, Park Lane, London, W.1 (the Congress headquarters), and after this session, Prof. W. L. Bragg, F.R.S., will present the Fourth Edward Williams Lecture, entitled "The Atomic Pattern of Metals." Tuesday afternoon, Wednesday morning, and all day Friday, June 16, are to be devoted to the discussion of almost forty Papers which will be presented to the Congress. The Friday afternoon has been set aside for a joint meeting with the Iron and Steel Institute.

In addition to these technical sessions, at which all phases of ferrous and non-ferrous foundry practice and metallurgy will be discussed, are the periods—Wednesday afternoon, June 14, and all day Thursday, June 15—which are scheduled for works' visits. Eleven companies in London and the Home Counties have kindly consented to open their works to Congress delegates, and the Director of the National Physical Laboratory has generously offered to show a party round the metallurgical section of the Laboratory.

Apart from the Reception by the Government, on whose behalf Lord Runciman, Lord President of the Council, and Lady Runciman will receive the guests, other social functions are the Annual Banquet on Wednesday, June 14, the Reception to be given by Mr. W. B. Lake, J.P., President of the Congress, and Mrs. Lake, on Thursday, June 15, and the garden party by Mr. and Mrs. Barrington Hooper, on June 11. Saturday, June 17, will be devoted to an excursion to Windsor Castle and on the River Thames.

A tour of the principal foundry centres of Great Britain has been arranged to follow the Congress, and is divided into two sections : June 18 to 24, and June 25 to 30. Delegates may participate in either the first or both weeks of the tour, during which they will be able to inspect twenty-six of Britain's leading foundries. Hospitality will be extended to a large extent by the local Branches of the Institute of British Foundrymen. Both during the Congress and the Post Congress Tour, a full programme of sightseeing excursions and visits to industrial establishments has been arranged for ladies.

Detailed particulars concerning the Congress are set out below and further information can be obtained from the organisers, the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3. Those wishing to participate are asked to make early application on the forms supplied by the Institute.

PROGRAMME

Sunday, June 11

3.0 p.m.—Garden Party to meet overseas delegates and ladies by kind invitation of Mr. Barrington Hooper, C.B.E., and Mrs. Hooper, at their home, Southward, Mount Park, Harrow. Coaches will leave the Dorchester Hotel, Park Lane, London, W.1, at 2.15 p.m., to convey delegates and ladies to Harrow. On return, coaches will arrive at the Dorchester Hotel at about 7.30 p.m.

Monday, June 12

11.0 a.m. to 5.0 p.m.—Registration Office and Information Bureau will be open at the Dorchester Hotel (Adams Room), Park Lane, W.1 (ballroom entrance).

10.30 a.m. to 5.0 p.m.—Committee and council meetings of the Institute of British Foundrymen at the Dorchester Hotel, Park Lane, London, W.1.

5.30 p.m.—Annual general meeting of the Institute of British Foundrymen (members only).

Tuesday, June 13

10.0 a.m.—Congress opens at the Dorchester Hotel (ballroom entrance). (All delegates and their ladies.)

Official opening of the Congress by the Rt. Hon. the Lord Mayor of London (Sir Frank Bowater, Kt.).

Reply on behalf of overseas delegates by Dr. Guido Vanzetti (President, International Committee of Foundry Technical Associations.)

Presentation of the Oliver Stubbs Gold Medal.

Presentation of the E. J. Fox Medal.

Vote of thanks to the Lord Mayor of London by Mr. J. Hepworth, J.P., M.P., President, the Institute of British Foundrymen.

Induction of the new President and Vice-Presidents of the Institute of British Foundrymen.

11.15 a.m.—Presidential address by Mr. W. B. Lake, J.P.

11.45 a.m.—The fourth Edward Williams Lecture:—"The Atomic Pattern of Metals," by Prof. W. L. Bragg, O.B.E., D.Sc., M.A., F.R.S., Nobel Laureate, Director of the Cavendish Laboratory in the University of Cambridge.

1.0 p.m.—Congress adjourns for luncheon.

1.15 p.m.—Buffet luncheon at the Dorchester Hotel.

2.30 p.m.—Congress resumes. Technical session:—Presentation and discussion of Papers. (For full list of Papers to be presented see Foundry Trade Journal, March 23, Page 250.)

4.30 p.m.—Meeting of the International Committee on Testing Cast Iron. (Committee members only.)

5.30 p.m.—Congress adjourns.

Evening.—Reception by His Majesty's Government at Lancaster House, London, W.1. The Rt. Hon. the Lord Runciman, P.C. (Lord President of the Council) and Lady Runciman will receive the guests. (All delegates and their ladies). (Evening dress.)

Wednesday, June 14

9.30 a.m.—Congress resumes at the Dorchester Hotel. Technical sessions:—Presentation and discussion of Papers.

12.30 p.m.—Congress adjourns for luncheon.

12.45 p.m.—Buffet luncheon at the Dorchester Hotel.

2.1 p.m.—Train departs Charing Cross Railway Station (platform No. 4) for visit to the works of (5) J. & E. Hall, Limited, Dartford. (Makers of refrigerative apparatus, and escalators; ferrous and non-ferrous foundries). Delegates participating in this visit will have to leave the Dorchester Hotel at 1.20 p.m. Delegates will find their own way to Charing Cross Station.

2.0 p.m.—Coaches leave the Dorchester Hotel for visits to the following works:—(6) Ealing Park Foundry, Limited, South Ealing. (General ironfounders; Meehanite process). (Party limited to 30). (7) Sterling Manufacturing Company, Limited, Cubbitt Town. (Makers of domestic laundry equipment; vitreous enamelling shop). (8) R. & A. Main, Limited, Upper Edmonton. (Gas cooker manufacturers; vitreous enamelling shop). (9) Gillett & Johnston, Limited, Croydon. (Bell founders; non-ferrous foundry). (10) Glacier Metal Company, Limited, Wembley. (General non-ferrous founders; mechanised foundry). (Party limited to 50). *Note.*—Delegates may participate in *only one* of the above visits, 5, 6, 7, 8, 9, or 10, as each occupies the whole of the afternoon. On return, motor coaches will arrive at the Dorchester Hotel at about 5.45 p.m. Those on the visit to J. & E. Hall, Limited, will arrive at Charing Cross Station at 6.6 p.m.

7.0 p.m.—Reception by Mr. W. B. Lake, J.P., President of the Institute of British Foundrymen, and Mrs. Lake, and Dr. Guido Vanzetti, President of the International Committee of Foundry Technical Associations, and Signora Vanzetti, prior to annual banquet.

7.30 p.m. to 1.0 a.m.—Annual banquet at the Dorchester Hotel, Park Lane, W.1. (Chairman: Mr. W. B. Lake, J.P.). The banquet will be followed by dancing until 1.0 a.m. (All delegates and ladies). (Evening dress).

Thursday, June 15

Delegates may participate in one or both of the half-day works visits, 12 and 13, or in one of the whole-day visits Nos. 14, 15, or 16.

Half-Day Visits.

9.15 a.m.—Motor coaches leave the Dorchester Hotel, Park Lane, W.1, for a half-day visit to the works of:—(12) Belling & Company, Limited, Enfield. (Electric heater and cooker manufacturers; vitreous enamelling plant).

Motor coaches will return delegates to the Dorchester Hotel at about 12.45 p.m. Delegates will make their own arrangements for luncheon.

2.0 p.m.—Motor coaches leave the Dorchester Hotel, Park Lane, W.1, for half-day visit to:—(13) The National Physical Laboratory, Teddington. On return, motor coaches will arrive at the Dorchester Hotel at about 5.30 p.m.

Whole-Day Visits.

(14) Crane, Limited, Ipswich. (Malleable ironfounders), and E. R. & F. Turner, Limited, Ipswich (flour mill engineers).

8.15 a.m.—Depart Liverpool Street Station by train. (Delegates will find their own way from their hotels to the station. Breakfast may be taken on the train if desired).

10.2 a.m.—Arrive Ipswich. Transfer to works by motor coach.

10.30 a.m.—Arrive Crane, Limited, Nacton Works.

12.30 p.m.—Luncheon at the Aero Club, Ipswich. (By kind invitation of Crane, Limited.)

1.30 p.m.—Depart Aero Club by motor coach.

1.45 p.m.—Arrive E. R. & F. Turner, Limited.

3.0 p.m.—Depart for sightseeing tour of Ipswich.

4.45 p.m.—Arrive railway station.

4.54 p.m.—Depart Ipswich by train.

6.32 p.m.—Arrive Liverpool Street Station, London.

Note.—Motor coach transport in Ipswich is by the kind invitation of Crane, Limited.

(15) Bagshawe & Company, Limited, Dunstable (malleable ironfounders and makers of conveyors), and a visit to Whipsnade Zoo.

8.30 a.m.—Motor coach departs from the Dorchester Hotel.

10.15 a.m.—Arrive Bagshawe & Company, Limited.

12.0 noon.—Depart Bagshawe & Company, Limited.

12.30 p.m.—Luncheon at Whipsnade Zoo. (By kind invitation of Bagshawe & Company, Limited.) (At luncheon, gentlemen will be able to join those ladies who have visited Currant & Creak, Limited, Luton, in the morning. During the afternoon, ladies and gentlemen will be able to inspect the Zoo.) (*See Ladies' Programme.*)

4.30 p.m.—Depart Whipsnade Zoo by motor coach. (Motor coaches will start from outside the main entrance to the Zoo.)

6.30 p.m.—Arrive at the Dorchester Hotel.

(16) Ford Motor Company, Limited, Dagenham (automobile manufacturers), and river trip through Port of London.

8.45 a.m.—Depart Westminster Pier by m.v. "Royal Princess." (Westminster Pier adjoins the Houses of Parliament. Delegates will find their own way there.)

11.0 a.m.—Arrive Ford Motor Company, Limited, Dagenham.

12.30 p.m.—Luncheon by kind invitation of the Ford Motor Company, Limited.

3.30 p.m.—Tea by kind invitation of Ford Motor Company, Limited.

4.0 p.m.—Depart Ford Motor Company, Limited.

6.30 p.m.—Arrive Westminster Pier.

8.30 p.m. to 1.0 a.m.—Reception at the Dorchester Hotel, Park Lane, London, W.1, by invitation of Mr. and Mrs. W. B. Lake. (All delegates and ladies.) (*Evening dress.*)

Friday, June 16

9.30 a.m.—Congress resumes at the Dorchester Hotel. Technical Sessions:—Presentation and Discussion of Papers.

11.30 a.m.—Meeting of the International Committee of Foundry Technical Associations. (Committee members only.)

12.30 p.m.—Congress adjourns for luncheon. (Delegates will make their own arrangements for luncheon.)

2.30 p.m.—Congress resumes at the Dorchester Hotel. Joint meeting with the Iron and Steel Institute. Presentation and Discussion of Papers.

5.30 p.m.—Congress closes. Evening free.

Saturday, June 17

ALL-DAY EXCURSION TO WINDSOR CASTLE AND ON RIVER THAMES.

9.20 a.m.—Depart Paddington Railway Station by train.

10.0 a.m.—Arrive Windsor. Transfer to Windsor Castle. Inspection of Castle.

12.0 noon.—Depart Windsor Castle.

12.15 p.m.—Luncheon at the Castle Hotel, Windsor.

2.0 p.m.—Depart from Windsor Bridge by steamer for trip on River Thames *via* Maidenhead and Cookham. Tea will be served on board.

5.0 p.m.—Arrive Bourne End.

5.13 p.m.—Depart Bourne End Railway Station by train.

6.27 p.m.—Arrive Paddington Station, London. Evening free.

LADIES' PROGRAMME

Sunday, June 11

3.0 p.m.—Mr. Barrington Hooper, C.B.E., and Mrs. Hooper invite ladies to attend a Garden Party at their home at Harrow. (*See General Programme.*)

Monday, June 12

Free for sightseeing. The Registration Office and Information Bureau will be open at the Dorchester Hotel (Adams Room), Park Lane, W.1, to give assistance and information.

Tuesday, June 13

10.0 a.m. to 11.15 a.m.—Ladies are invited to attend the Opening of the Congress, at the Dorchester Hotel. The remainder of the morning will be free.

1.15 p.m.—Buffet luncheon at the Dorchester Hotel.

3.0 p.m.—A Conducted Tour of the Houses of Parliament. Ladies are asked to find their own way to the Houses of Parliament, and to assemble near the public entrance. Buses Nos. 12, 32, 88 and 121 pass the Marble Arch end of Park Lane, and also the Houses of Parliament.

Evening.—Reception by His Majesty's Government. (*See General Programme.*)

Wednesday, June 14

Motor coaches will leave the Dorchester Hotel, Park Lane, W.1, at 9.30 a.m. for Visit No. 1 only. On return coaches will arrive at the Dorchester Hotel about 12.30 p.m.

Ladies are asked to find their own way to Visits Nos. 2, 3 and 4.

Visits to *one* of the following:—

9.30 a.m.—(1) J. Lyons & Company, Limited, Cadby Hall, Kensington, London. (Large firm of confectioners and caterers; Cadby Hall is the centre for the preparation and distribution of food to all London cafés and restaurants in this organisation.) (Party limited to 40.)

10.0 a.m.—(2) Wallace Collection, Hertford House, Manchester Square, W.1. (Art gallery and *objets d'art.*)

10.0 a.m.—(3) National Gallery, Trafalgar Square, W.C.2. (Art gallery.)

10.0 a.m.—(4) Tate Gallery, Millbank, S.W.1. (Art gallery.)

1.0 p.m.—Buffet luncheon at the Dorchester Hotel.

2.45 p.m.—Visit to Derry & Toms, Limited, Kensington, London. (Large departmental store.)

At the kind invitation of Derry & Toms, Limited, tea will be served on the roof garden at the store. Ladies will make their own arrangements for transport to the store and are asked to assemble in the restaurant lounge. Buses Nos. 9, 46 and 73 pass the Hyde Park Corner end of Park Lane and also Messrs. Derry & Toms, Limited's, store. Alternatively, an underground train (westbound) may be taken from Hyde Park Corner Underground Station, alighting at Kensington High Street Station, which is close to the store.

7.0 p.m.—Reception by Mr. and Mrs. W. B. Lake and Dr. and Signora Guido Vanzetti, prior to Annual Banquet. (*See General Programme.*)

Thursday, June 15

Ladies may *either* participate in Visit No. 17 *or* have the morning free *and* in the afternoon attend Visit No. 18.

(17) Visit to Currant & Creak, Limited, Luton (hat manufacturers), and Whipsnade Zoo. (Party limited to 30.)

9.0 a.m.—Coach leaves the Dorchester Hotel, Park Lane, W.1.

11.0 a.m.—Arrive Currant & Creak, Limited.

12.0 noon.—Depart Currant & Creak, Limited.

12.30 p.m.—Luncheon at Whipsnade Zoo, by kind invitation of Bagshawe & Company, Limited. (At luncheon, ladies will be able to join those gentlemen who have visited the foundry of Bagshawe & Company, Limited, in the morning.)

2.0 p.m.—Ladies and gentlemen will be able to inspect Whipsnade Zoo.

4.30 p.m.—Depart Whipsnade Zoo (main entrance) by coach.

6.30 p.m.—Arrive at the Dorchester Hotel. Those ladies who do not participate in Visit No. 17 will make their own arrangements for luncheon.

2.30 p.m.—Motor coaches will leave the Dorchester Hotel for a visit to—

(18) The Hall of the Worshipful Company of Barbers.

This company is one of the 78 Livery Companies of the City of London still in existence. These Livery Companies, which derive their name from the assumption of a distinctive dress or livery by their members in the 14th Century, are the survivals of the craftsmen's guilds of the Middle Ages. In those days, surgeons also came under the title of barbers, and visitors to this hall will be able to inspect priceless relics of a bygone age, as well as many beautiful works of art. This hall is one of the few Livery Company Halls which survived the Great Fire of London in 1666.

Tea will be served by kind invitation of the Worshipful Company of Barbers.

8.30 p.m.—Reception at the Dorchester Hotel by Mr. and Mrs. W. B. Lake. (*See General Programme.*)

Friday, June 16

9.45 a.m.—Motor coaches will leave the Dorchester Hotel for a Tour of London.

Ladies will travel *via* Piccadilly Circus, Trafalgar Square, Fleet Street, St. Paul's, London Bridge, Tower Bridge, to the Tower of London. Returning *via* Eastcheap, Cheapside, Guildhall, Victoria Embankment, Pall Mall, St. James' Street, to the Dorchester Hotel, arriving at about 12.30 p.m. Ladies will make their own arrangements for luncheon.

2.30 p.m.—Motor coaches will leave the Dorchester Hotel for an Excursion to Hampton Court and Kew Gardens. Tea will be served in Kew Gardens. On return coaches will arrive at the Dorchester Hotel at about 5.30 p.m. Evening free.

Saturday, June 17

All-day Excursion to Windsor Castle and on River Thames. (*See General Programme.*)

Golf

Through the courtesy of the Managing Committee of the Broxbourne Golf Club, this course has been made available to visitors to the International Foundry Congress. Those wishing to make use of this course should make contact with either Mr. H. W. Lockwood or Mr. F. Arnold Wilson, at the Registration Office and Information Bureau at the Dorchester Hotel.

Library and Reading Room

By kind invitation of the Councils of the Iron and Steel Institute and the Institute of Metals, members of the International Foundry Congress are invited to make use of the Institutes' Joint Library and Reading Room at their offices, No. 4, Grosvenor Gardens, London, S.W.1. These offices are a few minutes from the Dorchester Hotel.

Post-Congress Tour

A tour of the principal industrial centres of Great Britain has been arranged for those overseas delegates and ladies who wish to participate. This tour will start on Sunday, June 18, and a brief outline of the programme is given below.

SUNDAY, JUNE 18.—London to Banbury by train, motor-coach excursion, Leamington to Birmingham by train.

MONDAY, JUNE 19.—Works visits in Birmingham. Dinner at invitation of the Birmingham Branch of the Institute of British Foundrymen.

TUESDAY, JUNE 20.—Morning visits in Birmingham. Transfer to Derby by train. Afternoon, visits in Derby. Dinner at Matlock, by invitation of the East Midlands Branch.

WEDNESDAY, JUNE 21.—Works visits in Derby area. Transfer to Sheffield by train. Dinner-dance by invitation of the Sheffield Branch.

THURSDAY, JUNE 22.—Works visits in Sheffield. Transfer to Manchester by train. Reception by invitation of the Lancashire Branch.

FRIDAY, JUNE 23.—Works visits in Manchester. Dinner by invitation of the Lancashire Branch.

SATURDAY, JUNE 24.—Morning, works visits in Manchester. First part of tour ends; delegates may return to their countries if they desire. Tour continues by train to Windermere.

SUNDAY, JUNE 25.—Excursion in Lake District. Transfer to Glasgow by train.

MONDAY, JUNE 26.—Cruise on Firth of Clyde.

TUESDAY, JUNE 27.—Works visits in Glasgow area.

WEDNESDAY, JUNE 28.—Transfer to Edinburgh by train. Sightseeing in Edinburgh.

THURSDAY, JUNE 29.—Transfer to Newcastle by train. Works visits. Dinner by invitation of the Newcastle Branch.

FRIDAY, JUNE 30.—Works visits in Newcastle area. Transfer to London by the "Coronation."

New Stress-Relieving Furnace

SUITABLE FOR HIGH AND LOW TEMPERATURES

The heat-treatment operation known as stress-relieving is of great interest to all connected with welding, as it is certainly advantageous to the welded structure or vessel. It may not always be necessary, but this depends upon the use to which the welded article is put. This heat-treatment operation reduces the stresses left in a welded article in the vicinity of the welds and also reduces the hardness in the previously heat-affected plate. The welding operation being accomplished above the critical range causes localised hardening by the heat developed at the arc, and the hardness increases as the speed of welding increases. The leading insurance companies, recognising these facts, have formulated a number of rules dealing with stress relieving of welded pressure vessels.

A stress-relieving furnace of large size has recently been built by British Furnaces, Limited, for Daniel Adamson & Company, Limited, at Dukinfield. This furnace is 36 ft. long, 14 ft. wide by 14 ft. high inside the working chamber, and has some very interesting features which were considered necessary on account of the large internal volume and the close control of temperature required.

The furnace has been designed to take pressure vessels weighing from 25 to 30 tons and can be used for normalising at a temperature of 920 deg. C. as well as for stress relieving at 600 to 650 deg. C. A 25-ton charge can be heated together with the furnace to a temperature of 620 deg. C. in 5 hrs. and soaked for 1 hr. with a gas consumption of 61,500 cub. ft., the gas having a calorific value of 475 B.T.U.'s per cub. ft.

The furnace is of the gas-fired, roller-bearing bogie type, the car being operated by a hand winch. Only one man is required to operate the winch even when it is fully loaded and weighs approximately 150 tons. Sand seals are utilised on the sides and ends of the car. The troughs containing the sand are incorporated in the bogie instead of in the walls, as this arrangement enables the furnace operator to ensure there is enough sand in the troughs to make a good seal before the bogie is moved into the furnace.

The lining is of lightweight insulating refractory, backed up with efficient diatomaceous-earth insulation. The roof is of the flat suspended type having interlocking blocks of insulating refractory, the blocks being held up by heavy cast-iron bearers carried by horizontal joists which are in turn supported by vertical buckstaves so that the weight of the roof is not taken on the side walls.

The door had to be accommodated in the space below the track of the crane used for loading, and it was not possible to have a counterbalanced lifting door of the usual type. An electrically-operated side opening door was therefore installed. This door is controlled by two chains in a similar manner to a floor-operated travelling crane, but travels at a slower speed than a crane in order to avoid any shock. The door consists of a heavy cast-iron frame made in sections in which are special interlocked blocks of an extremely lightweight insulating refractory. Alternate blocks are threaded on vertical bars of special heat-resisting steel.

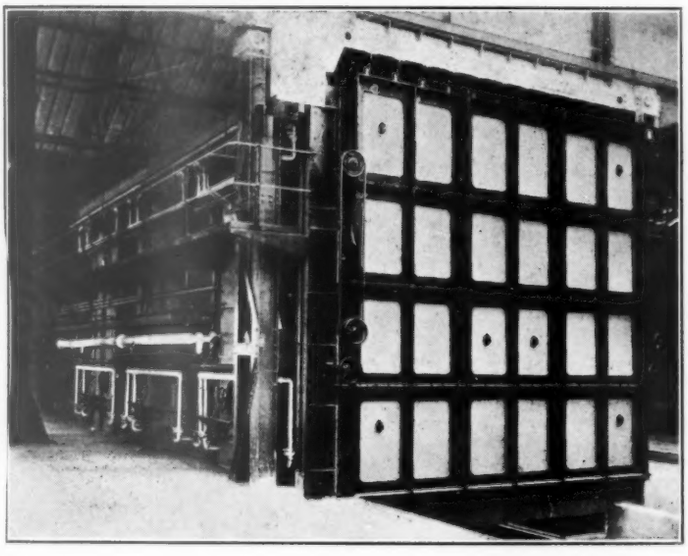
The whole of the furnace has been enclosed in a strong welded-steel casing heavily braced to ensure rigidity and freedom from distortion.

Gas-Burner Equipment

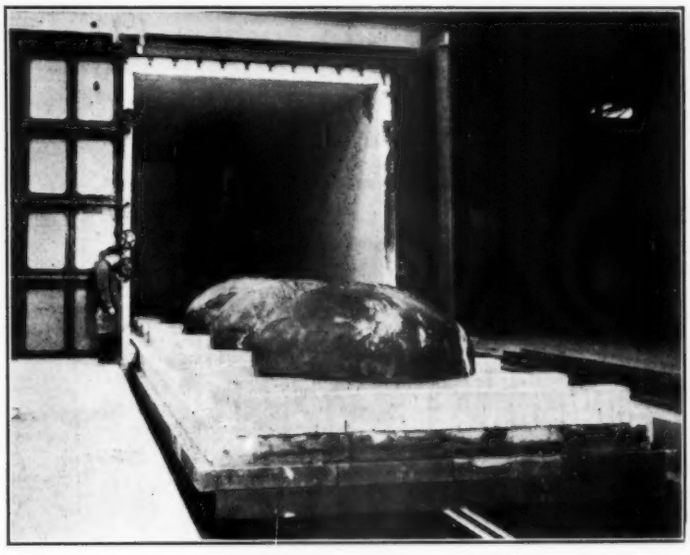
Heating is by means of 36 low-pressure burners arranged in 12 separate groups to suit the three zones of the furnace. The burners are of the automatic proportioning type, the gas and air being completely mixed before combustion occurs so that the short flames produced are localised in the tunnels immediately in front of the burner nozzles. With this system of heating there is no flame impingement on the furnace refractories, nor does it touch the material being heated. Half the burners are arranged to fire above, and the other half under the charge straight across the furnace from both sides.

Air is supplied to the burners at a pressure of 1 lb. per sq. in. from an electrically-driven fan mounted on top of the furnace. The pressure of the gas is 4 in. w.g.

The ideal method of heating at low temperatures such as those required for stress relieving is by the circulation of a large volume of comparatively low temperature gases at a high velocity. Apart from the method of heating employed the circulation of gases is very desirable because the hot products of combustion will enter every crevice, and uniformity of temperature is not dependent upon the ability of the metal being heated to conduct the heat. In the furnace under review six recirculating fans of special design to withstand temperatures as high as 920 deg. C. are employed. They are placed in the side walls near the roof and are connected to the base by means of vertical ports built in the side-wall buttresses. When the furnace is at a temperature of 650 deg. C. the gases are circulated three times a minute with an empty furnace and considerably more than this when it is charged.



General View of the Furnace.



View showing Bogie Removed and Interior of Furnace.

Catalogues Received

Industrial Heat Engineering. It is a commendable action on the part of the Incandescent Group to issue a catalogue detailing and illustrating the manufactures of the four associated firms, namely, The Incandescent Heat Company, Limited; the Selas Gas and Engineering Company, Limited; Controlled Heat & Air, Limited, and Metalectric Furnaces, Limited. Each one caters for some department of the foundry industry. The first named manufactures enamelling ovens; the second non-ferrous melting furnaces, the third core ovens, and the fourth electric melting furnaces. Whilst only one item has been picked out from each, it discloses the real benefit to be gained by such a grouping, as it makes for a better appreciation of the customer's requirements. A page is devoted to listing the manufactures of each company, and a second one to illustrating typical plants. Additionally one or two pages deal with the advantages of interlocking.

Mechanical Handling. Whilst Herbert Morris, Limited, of Loughborough, have issued special catalogues dealing with handling in the foundry industry, the more general aspects such as are set out in Book 196, "The Morris Industrial Highway," are not without interest for our readers. By examining the methods used in other industries, light is often shed on handling problems encountered in and around a foundry. It is for this reason we suggest to our readers that this 64-page well-illustrated catalogue is worth procuring and studying. It is available on application to Loughborough.

Mr. P. Denham Christie has been elected a director of Swan, Hunter & Wigham Richardson, Limited, shipbuilders and engineers, of Wallsend-on-Tyne. Mr. Christie is a son of Mr. J. Denham Christie, who resigned the chairmanship last year, and is the third generation of his family to be represented on the board of the company.

D

Manufacture of Very Light Engineering Castings*

By A. BURGESS

A hardy annual in almost all books on foundry practice is "Co-operation of Departments," upon which the efficiency of production depends. This subject should never be overlooked, especially at the commencement of a new batch of work which has no similarity with work already in production. The drawing office, machine shop, erecting shop, pattern-shop and foundry should all contribute their quota before the word "go" is given by the production department.

The design of any casting is obviously governed primarily by the function it is required to fulfil, and secondly by the metal to be used. A designer fully acquainted with foundry problems is a blessing of untold value to the foundry foreman, especially in foundries where materials of a varying nature are cast.

One outstanding job personally handled is a Diesel cylinder head, perhaps the smallest ever cast. From Fig. 1 it will be seen that the designer has very definitely aimed at a heavy section in the centre of the head to retain the heat in the combustion chamber and so assist the early combustion of the fuel. He was also keen on keeping down the cost of machining, which made the moulding of a sound casting a difficult proposition. Some parts of the casting

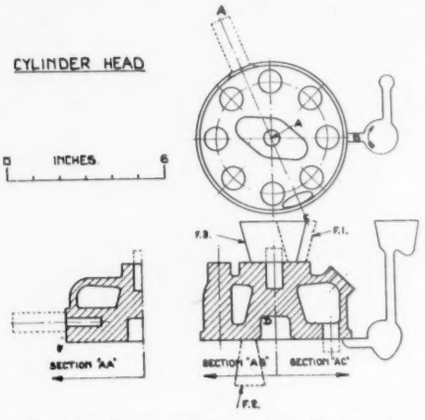


Fig. 1.—Plan and Sections of Small Diesel-engine Cylinder Head.

are subjected to 1,000 lbs. pressure per sq. in. Fig. 1 shows the casting as it was originally cored, which left no means of adequately feeding the thicker interior. Three attempts were made to secure a sound casting of what one might call a very simple nature, before a good one was produced.

Denseners were not entertained as the job might become a repetition one, and it is a personal opinion that chills or denseners of any description are not a success in the manufacture of high-pressure castings of small dimensions cast in green sand. The methods of running and feeding at the first attempt are shown dotted. The job was cast with the important face downwards to ensure a clean face at the cylinder joint, and the metal was introduced by a spinning gate with a dirt trap immediately over the spinner (B, Fig. 1). A feeder as large as possible was placed in position shown at A, but this did not prove adequate as an external sink occurred at point D, leaving the casting unmachinable.

The second attempt was cast in the reverse position with the cylinder joint face uppermost. Again a spinner and dirt trap were used in filling the mould, with the feeder placed at F2, but this proved insufficient as choking occurred between the combustion chamber and the jacket core, and an external sink was the result at point D again. The foundry executive then approached the drawing office and put his views forward, and as a result the centre core was removed and the combustion chamber made as large as possible to leave the minimum of machining at that point.

A third attempt proved more successful. In this case the job was cast as in the first instance, and a feeder as big as possible placed on the top centre boss, as shown at F3. The runner was not varied throughout the tests. Whilst the direction of taper of the centre of the casting was in the opposite direction to that which is usual for the orthodox method of feeding, it did not prevent the feeding head from doing its work well. The composition of the metal used was:—T.C, 3.2; Si, 1.8; Mn, 0.8; S, 0.06; P, 0.24, and Cr, 0.24 per cent.

Water-Cooled Manifold Castings

These castings were for the conversion of a Ford V8 engine into a marine set. The trouble with the job was due to the gases failing to escape from the cores sufficiently quickly to prevent the casting being blown. In other words, the designer had not provided sufficient outlets from the jacket at regular distances.

Little work has been published about the relation of the size of the outlet and the amount of surface area of the core covered with molten metal in a given time. Such data would assist in the production of good castings of this description at the first attempt, instead of the foundry having to prove its complaint of insufficient vents by making a bad casting or more at the outset. The author has never made any experiments on these lines, but what appear to him to be important factors governing the matter are (given a standard sand mixture and even ramming):—

(1) Volume of sand in core, which absorbs the gases generated between its grains.
(2) Surface area of core covered by metal.
(3) Time taken to cover core with molten metal.
(4) Size of outlets.
(5) Position of outlets.

As an example of the first three factors, one can imagine a core 3 ft. long, 1 ft. wide and ½ in. thick, to be covered with metal in 4 secs. and having one print 2 in. in diameter, the metal thickness being ¼ in. With it, compare a core 1 ft. cube, with the same print and covered with metal in the same time. The two cores have approximately the same surface area, but one has eight times more sand in it than the other. Any practical foundryman would be pessimistic about the results he might obtain from a job with the long thin core in it, but would never hesitate to tackle a job with the boxlike core as its only drawback. Although the same amount of gas is generated in each case, the second core is more capable of absorbing and storing it under a low pressure, whilst the 2-in. vent passes it to safety.

So far as factor (4) is concerned, it is desirable to make the outlets as big as possible, whilst in the case of factor (5) the position of the outlet is very important. Returning for a moment to the long flat core and imagine this set up on its end with the 2-in. dia. print distributed over the end and at the top, how much easier would be the task of securing a sound casting. The third factor could also be of much assistance now, as the reduction of the runner by 50 per cent. would give twice the pouring time and 4 secs. longer in which the gas could get away.

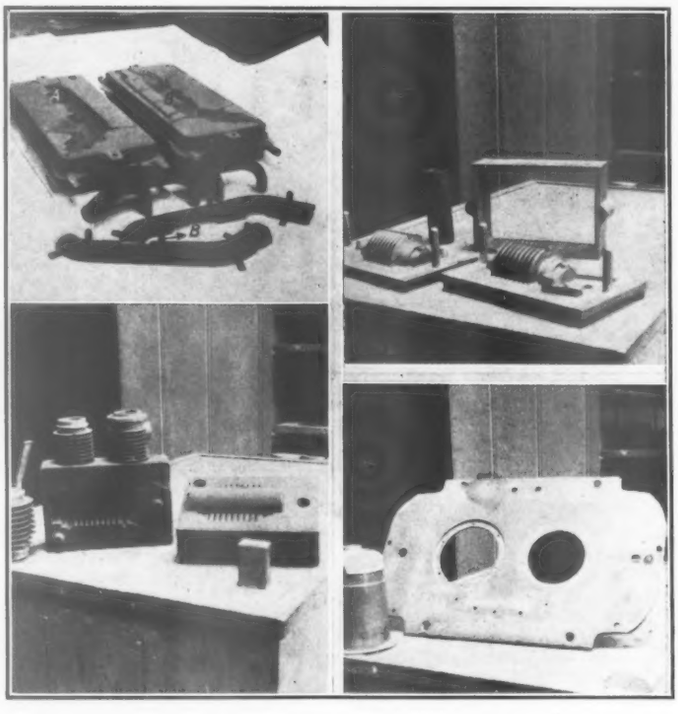


Fig. 2 (top left).—Water-Cooled Manifold Casting.
Fig. 3 (top right).—Tackle for Small Air-Cooled Cylinder Casting.
Fig. 4 (bottom left).—Half-Moulds and Castings of Air-Cooled Cylinder.
Fig. 5 (bottom right).—Pattern Plate for Electric-Motor Casing.

* A Paper presented to the Bristol Section of the Institute of British Foundrymen.

The manifold referred to above is shown in Fig. 2; it is 2 ft. 3 in. long with the bore tapering from 2 in. to 1½ in. dia., and a metal thickness of $\frac{5}{32}$ in. The section of the jacket core is ½ in. thick, which makes it a very difficult core to handle. The jacket core had seven prints, each only ⅝ in. dia. It was thought at the outset that these would be insufficient, and arrangements were made to have them increased to ¾ in. dia., and a further two added at point B, in the centre of a long stretch of jacket core originally without vent, other than along the length of the core. The first mould was made in green sand to be cast in a horizontal position, as this was the quickest method of production. Great care was taken to provide for the escape of as much gas as possible from the core, and a runner arranged as shown was used.

Whilst slow running would assist in allowing the gas to escape more freely, one has to bear in mind that the section of the casting is little over ⅛ in., and such a mould has to be poured quickly to prevent misruns. The author, therefore, tried to strike the happy medium, but the job blew and a waster resulted. In the next attempt efforts were confined to running the casting more slowly, so that more gas could escape from the core before the mould was filled with metal. With this in view it was cast at an angle of 40 deg. or so from the horizontal and the ingates were reduced considerably, although still using the same method of running. A riser was also placed at point A, Fig. 2, the highest point of the mould, and designed so that it increased very rapidly in diameter when it left the casting.

Special attention was given to the coremaking, and gentle ramming, careful wiring and good drying were carried out. The core used was made from 35 parts Zenith washed silica sand, one part fine sifted horse manure, and one part of a proprietary core cream—the batch being mixed in a screw type mixer. Perhaps a sand of greater permeability would have permitted of the elimination of the manure, but in the light-castings industry one cannot stock sand like granite chippings, and the manure assisted (after burning in the drying) in making a core which, when placed to the mouth, was easily blown through.

Before closing the mould a clay seal was placed on all the prints to prevent the metal capping over the ends of the core, which made sure the gases escaped freely through the holes provided for them. Whilst the castings were being poured a slight blowing was noticed in the risers, but these were of the flow-off type and designed so that they would not freeze up whilst the stream of metal was continuing in the runner. This allowed any trapped gases to pass harmlessly from the mould and a good sound casting resulted.

It might be thought that the job should have been cast on end, but the tackle was not so designed; furthermore, unless the mould was dried, one might expect a very rough or oversize casting at the bottom, owing to the higher pressure.

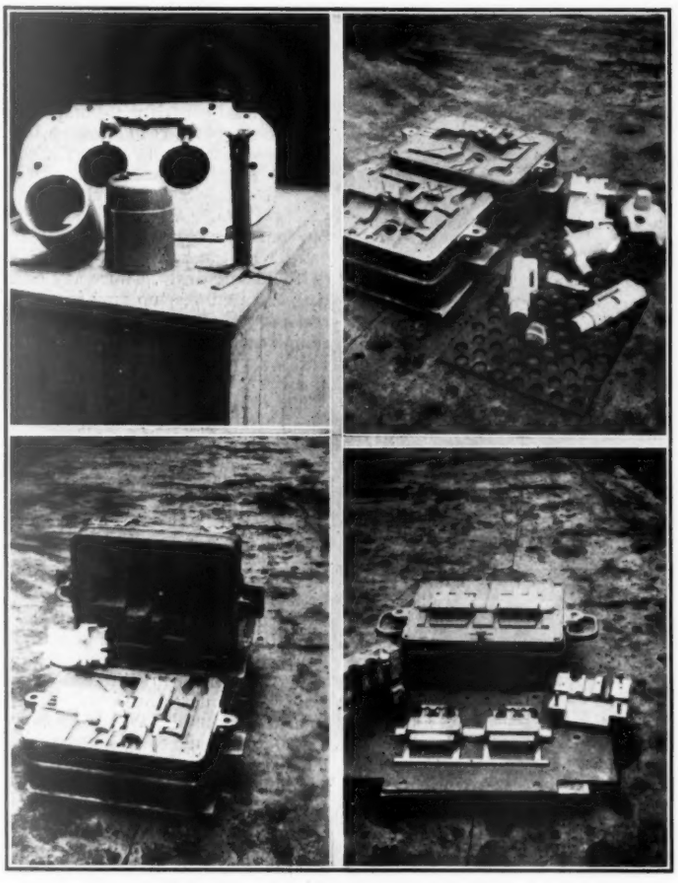


Fig. 6 (top left).—Pattern for Motor Casing.
Fig. 7 (top right).—Mould and Cores for Small Two-Stroke Cylinder.
Fig. 8 (bottom left).—Mould for Cylinder with Cores in Place.
Fig. 9 (bottom right).—Pattern-Plate and Bottom Half-Mould for Model Twin Steam Engine.

Air-Cooled Cylinder

Certain types of jobs made in some foundries with the minimum of trouble are to others nothing but nightmares, and one of these caused worry for some time. It was a small air-cooled cylinder or more correctly a number of cylinders of slightly different size which were occasionally wanted in batches of from 25 to 200. It will be agreed that a good clean casting of this type gives some difficulty at the outset.

Fig. 3 shows the tackle used. Two half-patterns made in gunmetal, with a perfect finish, are located very carefully on two metal plates each fitted with two guide pins. The brass plates are fitted also with locating lugs and sockets, which are reproduced in the mould and form a means of pairing the two half-moulds perfectly before pouring. The pattern of the runner and risers is also seen fastened to the plate.

The gunmetal frame seen at the back fits on the dowels of each plate and has about two thousandths of an inch clearance in the holes. It also has about five degrees of draw for easy removal when the mould is rammed up. The tube at the side is the barrel corebox. With the use of this frame and pattern-plates, oil-sand cores are made from a medium fine silica sand, mixed with a proprietary core cream.

No sprigs or pins are used in the fins and one has a mould which can be cleaned by blowing out well before casting and capable of withstanding the wash of the metal when thoroughly dried. The plates and frame serve for quite a number of cylinders, the pattern itself being taken off and others attached to the plates at will. A complete mould takes about four minutes to make. No side rapping of the pattern is allowed, as variation in the fin thickness results. It is therefore essential that the sand should not be sticky, and this calls for perfect dryness before mixing with the core oil.

Fig. 4 shows the half-moulds ready for closing, with the resultant casting on the left and two other types made in the same way. (A match box is shown in the foreground for the sake of size comparison.) Before pouring, the moulds are clamped together and placed on end, as many as is convenient. This is perhaps not a method for large-scale production, but is useful for small quantities. The method yielded one waster out of 400.

Electric Motor Casing

Fig. 5 shows a method of making an electric-motor casing, the size of the casting being 4 in. inside diameter and 7½ in. deep. The plate is designed to work on a hand-ram straight draw moulding machine, as it is a personal experience that jolt ramming is not always satisfactory with deep cods. It is a double-sided plate made by mounting two gunmetal patterns on a $\frac{5}{16}$ in. steel plate. They are secured by means of a flange and set screws; one pattern is shown fixed and one before mounting.

They are rather more complicated inside than can be seen in the picture, as two slight reductions in diameter and several bosses form part of the design. For this reason gunmetal as a pattern material is very useful. Its soldering properties enable any additions to be made quite easily, and bosses or facings, when fixed, can have a perfect solder fillet put round without trouble, giving a pattern which will give a streamlined finish to any casting.

Fig. 6 shows the pattern complete with runners ready for use. Whilst it appears that spinning runners were used they were not put on as such, but as dirt traps, as the spinning action is nullified when the cone is inverted as in this instance. The deep lift of this casting offered some trouble at first until the lifting irons as shown were designed to lift out the core or cod. These were cut from old gas piping and have proved very efficient, as the tube helps the escape of the gas, as well as providing a means of holding the sand rigidly in position—a slight slip of the cod would be fatal on such a thin sectioned casting.

Two-Stroke Cylinders

Fig. 7 illustrates a mould and a set of cores for a small petrol two-stroke cylinder, the type used in the small motor-boats so familiar at the

seaside pleasure parks. A double-sided plate is used on a jolt-squeeze straight draw moulding machine, making all the bottom halves first before turning over the plate.

Some moulders' idea of a vent is to make a hole as small as possible so as not to damage the mould, but personal preference is for a large one and this mould illustrates this practice. The runner and feeding riser are also shown very clearly, as are a large sump to pour into with two small ingates off the down gate and a heavy feeder over the centre. The cylinder is cast with the bore vertical, and as no bars are in the moulding boxes, perforated steel plates are clamped up the sides of the mould to hold in the sand. Boards are apt to burn and do not allow gases to escape so freely. These plates are bought cut to any size and cost about twice as much as boards but wear indefinitely.

Whilst on the question of boards, when the author joined his present firm most of the moulds were cast on wooden ones, which soon burned hollow and accounted for a good deal of scrap as well as being expensive to replace. Experiments were made with various materials, but finally an asbestos cement board was decided upon. These are made from "Sindanyo" sheets, $\frac{1}{2}$ in. thick, with two $\frac{3}{4}$ in. by $\frac{3}{4}$ in. by $\frac{1}{8}$ in. angle irons, the full width of the sheet, bolted on with countersunk bolts and nuts. These just allow the mould to be put down without the fingers being trapped. There have, since their inception, been no run-outs through the bottom, no swollen castings and already they have given five times the service of wooden boards, whilst the cost was only three times that of wood. Furthermore, they are still in service and are perfectly flat. Two of them are seen holding the moulds in Fig. 7.

The cylinder cores are all dried on aluminium shells, except the barrel core and the small one in the front. The prints are so designed that no studs or nails are used to hold them in position, a striking example being the long print on the expansion chamber core. Fig. 8 shows the cores set except for the top half-jacket. The cylinders are water-tested up to 80 lbs. and much trouble was experienced with porosity some three years ago, but the running and feeding method shown, together with careful control of the metal (especially the phosphorus content, which is never allowed to exceed 0.25 per cent.) gives excellent results, the percentage of wasters being very small indeed.

Fig. 9 illustrates a single-sided pattern-plate of a twin steam cylinder and crankcase combined, as used by model engineers in the pursuit of their hobby. This was originally made as one complete gunmetal pattern, but was divisible on the joint line so that it could be plate-mounted after test. When a sample casting had been approved, the pattern was divided and located on the plate very accurately, together with the runners and vents. By this method two castings per mould are obtained from one pattern, with considerable economy in pattern cost. The method of fixing them on the plate was by first machining the front edge of the plate parallel with the guide pin-holes and then bolting a strip of 1 in. by $\frac{1}{2}$ in. steel to it. From this to the patterns, packing pieces were laid on the plate until the patterns were the desired distance from the edge. The plate is rested on a moulding box located with tightly-fitting pins. From the pins, two further pieces of packing cut from the same bar set the patterns sideways. The patterns are then pressed firmly to the packings and clamped to the plate, after which plate and patterns are drilled simultaneously and bolted together. These packings are cut from stock bar correct to within about two-thousandths of an inch.

Patterns are assembled by the marking-off method, but where possible the practical method is used, as the plates are only black mild steel and the oxide scale on them is apt to let the drilling wander off the markings. It should be remembered that the pattern of the runner should only be one-half of its desired thickness, as it is reproduced in both halves of the mould. Fig. 9 shows a bottom half-mould with cores laid. The top is made in exactly the same way except that a down runner and two risers are placed where shown by the drilled holes in the patterns and connecting runner. A complete mould then produces two castings exactly similar, having the word "Sirius" and "Stuart" on opposite sides.

The corebox is made of aluminium to lighten its weight and is held together with the screw clamp whilst being rammed up. A boss is formed with the peg as shown in the left half, instead of two loose pieces. When located the peg does not project past the edge of the box but finishes on the same plane, so that the box may stand on this face whilst being rammed up. Finger and thumb grips are also provided to extract the peg. A sand mixture with good green bond is used, and the core is dried standing on its oblong face.

A few more double-sided plates are shown in Fig. 10. The back one has three control-column patterns which leave little room for running the castings, whilst two would obviously leave the box rather empty. They are poured with two ladles, one filling one casting, whilst the other two are filled at the same time to prevent bursting in.

The plate on the left is used in the making of gunmetal centrifugal-pump bodies. The other side of the plate is flat except for a round point under each casting. Some difficulty was experienced in laying these cores, as the prints in the bottom side of the mould were insufficient to steady them. An impression of the lay on the top part is now obtained by dusting parting powder on the bottom half and trying the top on (without any dust), before any cores are set. Setting them on the top part is then simple, as they rest securely on the large print and are located radially on the undusted prints of the branch. The bottom half-mould is then placed over the top and the whole turned into its casting position.

The other plate illustrates a job for which the Sindanyo moulding boards were very useful. Before their use a flash connected them all together, owing to the lift and downward thrust caused by the large surface area of the casting space.

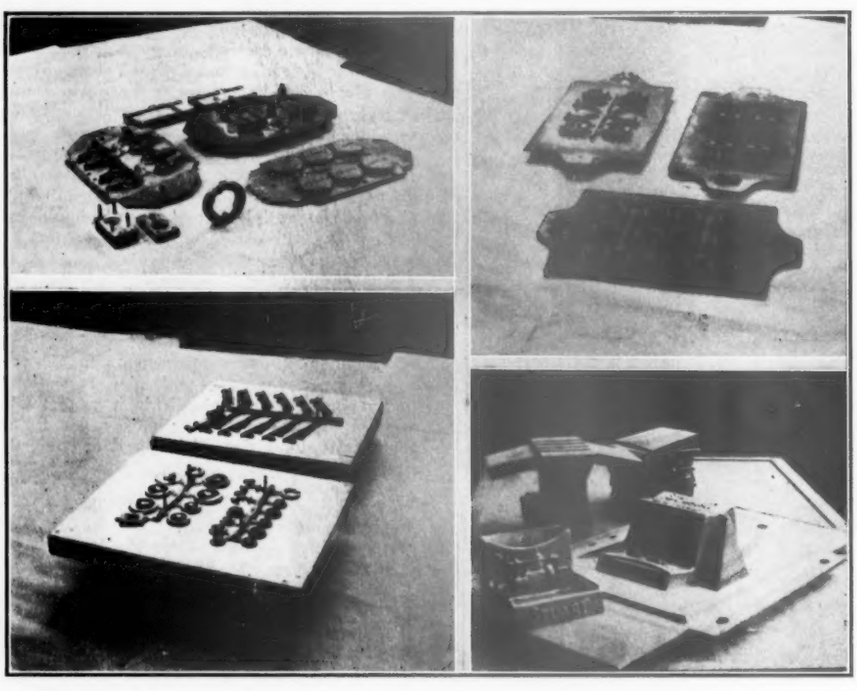


Fig. 10 (top left).—Double-Sided Pattern-Plates.
Fig. 11 (top right).—Double-Sided Pattern-Plates for Smaller Castings.
Fig. 12 (bottom left).—Patterns for Oddside Moulding.
Fig. 13 (bottom right).—Casting and Patterns for Advertising Novelty.

Small Pattern Plates

Coming to still smaller castings, Fig. 11 shows three double-sided plates which are in use with snap flasks on a Britanniæ press machine. Snap flasks, unlike good metal moulding boxes, are not always interchangeable and there are, as will be seen, adjustable pinholes on the plates, so that slight variations in different flasks can be overcome. The plates are checked for pin tightness before being used. The patterns are: (top right) bases for small electric motors; (bottom) end shields for the motors, all being cast in aluminium, and (top left) the patterns of the column and base of a small steam engine, which are cast in iron. The view is of the bottom side of this plate and attention is drawn to the main runner. On the top side of the plate is a duplicate of this which provides a dirt trap for any inclusions that might be making their way to the castings.

Oddside Moulding

Some patterns do not lend themselves to plate mounting, as the joint line, cost of multiple patterns or lack of large quantities required do not justify their mounting. Oddside moulding is then resorted to. Usually the patterns are made of gunmetal and a variety is shown in Fig. 12. Two or more brass pegs of sufficient strength to carry the pattern are screwed into each where the runner will be. By means of these pegs they are then located and soldered to a ridge or main runner after having been carefully arranged on to a sand oddside. Good judgment is required in arranging miscellaneous work. One casting of rather bigger dimensions than the others may result in a number of the smaller ones misrunning.

Before a plaster oddside is cast, the solder is filed where it contacts with the patterns, so that the resultant castings break off from the runner without damage and obviously with as little surplus metal left on as possible. Powdered resin

has been found the best parting material for dusting the patterns before pouring the plaster on to them. The wooden frames should be rigidly made and designed to hold as little plaster as the job will permit. When pouring the plaster of paris quick action is necessary; mix it as thick as possible, for this gives a harder oddside, and when pouring do not let the stream fall on to the patterns, as this washes off the resin.

It is wise to remove the patterns from the plaster about two minutes after pouring; that is, when it should be almost set. They can then be rapped enough to give a slight clearance for a coat of shellac varnish on the plaster before putting it into commission. Each main runner has a small rapping hole and two guide pegs to assist in the extraction of the patterns from the mould.

For the extremely fine finish required on this model work it is necessary to keep the sand in excellent condition. The floor sand used in the facing mixture is always taken from the benches making this fine work, as other heaps of old sand get contaminated with spent core sand of much larger grain size. About four times a year all the sand is passed through an $\frac{1}{8}$-in. mesh sieve, and the amount of shot and small scrap extracted is astonishingly large. The facing sand used is a mixture of 10 parts floor sand, one new Mansfield and one part superfine coal-dust.

Whilst dealing with the finish of castings, it may be mentioned that quite a large percentage of small firms cannot adopt the more modern types of cleaning machines, especially those of the shot-blast type. If one has to use the old-fashioned tumbling barrel it is wise to keep the diameter of the drum as small as possible and increase its capacity longitudinally. As a rough guide, a 15-in. dia. barrel gives excellent results on work not exceeding 6 in. long.

Advertisement Castings

When castings are to be used as advertising media, a superfinish is required, and Fig. 13 shows a casting and patterns of such character. It is an ash tray, pencil and catalogue or card stand or a paper weight. The angles offered some moulding difficulties from a production sense, and it was decided to bridge two patterns together and block the centre out with a core. The core is seen at the left of Fig. 13 and carries four connecting runners. This core had to be perfect in every detail, as it forms part of the outside of the casting and makes the recess to receive the postcards. Wedge-shaped blocks were made as seen at the back to carry the arms of the core whilst being dried.

Even with a perfect corebox and an exceptionally steady coremaker, one cannot expect him to lift the box off the core perfectly when only $1\frac{1}{2}$ degrees of taper is allowed. To overcome the risk of bad draws, the method shown in Fig. 14 was adopted. A cast-iron plate with two pins locates into two brass bushes screwed to the box. When the core is rammed up the impression of the runners is made with the loose piece. Two of the wedge-shaped blocks and the core plate are placed into position, and then the guiding-off plate is located. After turning over, the box is slightly rapped and lifted off, leaving the core ready for the stove. Fig. 15 shows the box removed.

Multi Box-Part Moulds

Occasionally patterns require more than one mould-joint line to extract them, and this necessitates a mould of three or more parts. Three-part moulds made with two boxes are not new, but they seem to have gone out of favour in recent years. Few things commend this arrangement over the three-box method, but where two boxes can be turned over by one man and three cannot, a good deal of time is saved and, of course, more moulds can be made with a given number of boxes.

Fig. 16 shows the tackle used for the manufacture of a small coupling in L.33. Each casting is about 4 in. diameter by $2\frac{1}{2}$ in. deep. Four half-patterns are joined together with a runner and guide-pegs as previously illustrated; the other halves fit on separately. These rest on a follow board which is tapered to give the desired joint and (as will be seen) has its interior the same depth as the patterns. The first operation is to ram inside and outside the patterns and strickle off any surplus sand. Having made a parting joint the bottom box is located by the pinholes and rammed up. After rolling the job over, the follow board is guided off by the pins, leaving the joint ready made, and the top is duly rammed up. Fig. 17 shows a complete mould but illustrates in the fore half how the follow board leaves the joint. It also shows the top half-patterns removed, this being done simultaneously. The top part is now placed on the bottom. After rolling over and lifting off the bottom half, the other half-patterns are extracted separately, care being taken to prevent any dirt falling into the mould, as this is difficult to extract. The extraction of dirt is, in fact, the biggest drawback to this method of moulding, but with care and good patterns it can be overcome. The shape with likeness to a rivet head seen on the centre of each mould acts as a key and prevents the centres moving when the mould is turned over. These are, of course, formed by the board.

A complete set of castings with the runner still attached is shown in Fig. 18.

Engineers manufacturing internal-combustion engines demand quite a variety of metal mixtures, and this is aggravated by the demand of the model section of the author's firm for very soft iron. Several firms run their high-pressure castings from a cupolette—an essentially satisfactory method. If only one cupola is available, however, the melting practice has to be very closely controlled. As West pointed out in the Institute Proceedings of 1932-3, phosphorus plays a very important part in the pressure-tightness of castings. Contamination by the more common irons must therefore be carefully avoided.

A day's run therefore contains a first charge of low-phosphorus iron with not more than 0.3 per cent., followed by any high-pressure or refined irons for such work as cylinders and heads. This is followed by another low-phosphorus charge. The charges are then increased in phosphorus and silicon as the work demands, until at the end of the blow the furnace is running an iron with something like 1.3 per cent. phosphorus and 3.5 to 4 per cent. silicon. The scrap from the various mixings is stored separately.

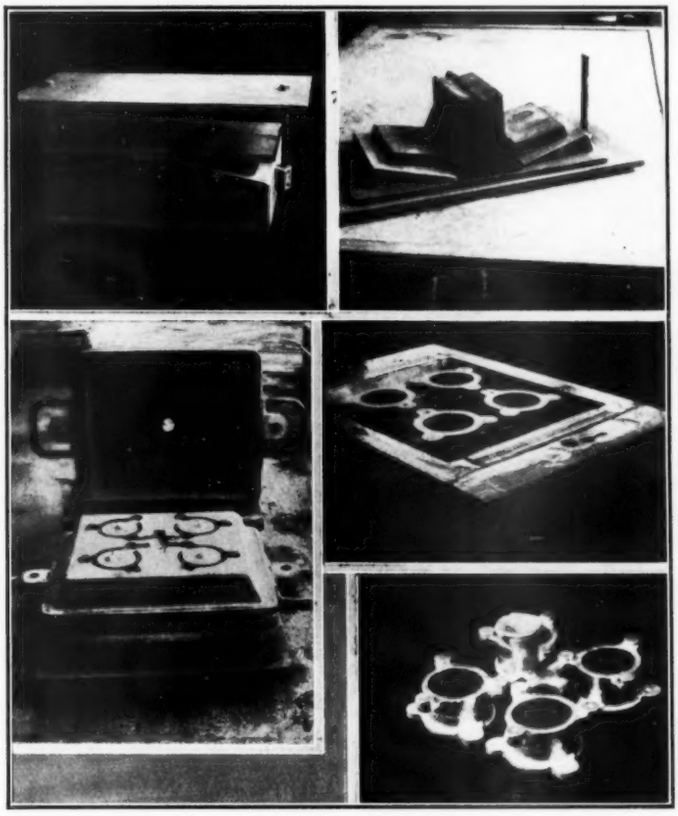


Fig. 14 (top left).—Method to Overcome Bad Draws.
Fig. 15 (top right).—Core Box Removed, showing Core.
Fig. 16 (centre right).—Tackle for Moulding Small Couplings.
Fig. 17 (bottom left).—Completed Mould for Four Couplings.
Fig. 18 (bottom right).—Complete Set of Couplings, with Runner.

Conclusion

It will be realised that the examples given are based on the practice of a quite small foundry, serving principally the needs of the engineering concern of which it forms a part. This foundry came into existence after the war, when it was found impossible to obtain the very small castings used in the model-engineering portion of the business.

For some 12 years it produced only crucible castings in iron and non-ferrous metals, the larger castings needed for the commercial engines being bought. With increasing production a larger output was needed. The present foundry was built in 1931. The organisation is a comparatively small one of some 200 hands and co-operation between the various departments is very close.

In conclusion, the author would like to acknowledge the help and encouragement he has received from the management of his company in the preparation of this Paper, and for permission to give exact details of actual methods.

Centrifugal Castings*

By A. R. PARKES

Centrifugal or spun-iron castings are coming into daily use. One sees spun-iron pipes of prodigious sizes by the roadside ready to be entombed as gas or water mains; one is told by car and commercial-vehicle maintenance authorities that centrifugally-cast cylinder liners are much better than a rebore; yet another authority states that centrifugally-cast brakedrum liners give safer braking and minimise wear. It has been stated that the Director of Technical Development has approved of new cast iron alloys for aero-engine spun cast piston-ring blanks. It is therefore interesting to examine this enterprising branch of founding.

Theory of the Process

A centrifugal casting is essentially one which is produced by spinning a mould at high speed and pouring into it molten metal; the centrifugal force, acting at right angles to the axis of rotation, throws the molten metal outwards and presses it against the mould surface, with which it then rotates. Upon solidification a casting is produced with an outer periphery corresponding to that of the mould, the casting machine is stopped, and this casting ejected. It will be realised that the easiest type of casting to make by this means is a hollow cylinder.

One's first reaction in trying to visualise this casting procedure is one of apprehension; it seems dangerous for molten metal to be whirled about at perhaps thousands of surface feet per minute in an open-ended mould. One would imagine, at least, that the new Factories Act had something to say about the safety of these machine operators. When, however, it is realised that there is only one direction in which the molten metal can flow, and that at right angles to the spinning axis, then the hazards of centrifugal casting are found to be even lower than in normal foundry practice. Just as a bucket of water may be whirled round and round with less danger of spillage than in being carried over uneven ground, so may molten metal be thrown about in a rotating mould with comparative safety.

Centrifugal castings are chiefly produced as hollow cylinders, chiefly as sand and metal spun pipes (according to the mould material used), cylinder liner castings, piston ring pots and non-ferrous sleeving. The same process has been developed, however, for more complicated moulds such as colliery truck wheels, non-ferrous worm wheel blanks and "cored" bars, brake-drums, pistons, and valve-seat inserts. In these instances the centrifugal force is utilised to pressure-feed complicated castings.

Spun-Iron Pipe Casting

For large pipe castings a water-cooled steel or sand-lined mould is rotated on rollers at high speed while molten cast iron from an automatic tilting ladle is fed along a trough inside. Metal is first delivered at the extreme end of the mould and then the trough is automatically withdrawn so that a spiral path is traced on the inner mould surface by the impinging stream of metal. The careful adjustment of the speed of the mould, the rate of delivery of molten metal and the withdrawal of the trough regulate the thickness of the casting, and a clean inner bore can be thus produced free from spiral markings. The "bell" end of the pipe is formed by a short sand core at one end of the mould. A minimum inside mould surface speed of the order of 1,200 ft. per min. is essential before the smooth inner surface of the mould will pick up and carry the molten metal by frictional forces. In some cases pipes are made in cold metal moulds and have to be annealed for machinability; other processes utilise the effect of a hot mould to give freedom from chill, while a recent development is the introduction of a finely powdered silicon inoculant to the mould surface just before the stream of molten metal impinges to give grey iron in comparatively cool moulds. The pipe solidifies quickly, and the machine is stopped. Diametric contraction of approximately 0.01 in. per inch diameter, two-thirds of which takes place before the casting cools to 600 deg. C. (withdrawal temperature), suffices to free the casting from the mould, and it is mechanically withdrawn. After a light dressing of the mould surface and the pouring trough a second casting can be made, and so on.

It will be quite clear that such precision casting procedure and mechanical control for producing pipes up to 36 in. dia. and 24 ft. long cannot be housed in an ordinary foundry, and practically all manufacturers of spun iron castings have an independent foundry for the purpose.

Cylinder-Liner and Piston-Ring Pot Manufacture

Centrifugal castings for cylinder liners and piston rings are usually made in a different type of machine from pipes. The castings are about

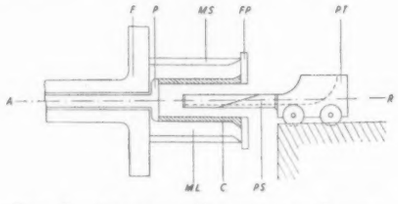


Fig. 1.—Sectional Diagram of Layout of Centrifugal Casting Machine.

12 in. to 18 in. long, from 2 in. to 30 in. in diameter, and are cast with a flange at one end for subsequent automatic lathe chucking; their bore is usually a plain cylinder and no cores are inserted.

The mould for these castings is, to all intents and purposes, bolted to the face plate of a lathe which has a hollow spindle and is driven at high and variable speed either by self-contained motor or overhead drive. Fig. 1 is a sectional sketch which shows the important principles of this type of machine, though, of course, structural details cannot be given as these are more or less trade secrets. MS is the mould shell bolted to the lathe type faceplate F and rotated about the axis AR. FP is a quickly removable front plate having an orifice of the internal diameter of the required casting. ML is the mould liner with which the molten metal actually comes in contact, while P is the plunger, actuated from the back of the machine, which ejects the casting, C, after the removal of the front plate. The casting is poured by hand ladles through a pouring trough PT and a helically shaped spout PS, which are daubed with refractory clay. The trough and spout can be withdrawn when pouring is complete. The operation of the machine is a fine example of motion study; the operator adds blacking to the mould, assembles the front plate, pushes in the pouring spout, starts the machine, and, while speed is building up, collects metal. The metal is poured, or almost thrown, into the trough and fills the mould to an even radial thickness till it overflows over the edge of the face plate FP. The overflow of metal causes a catherine-wheel effect but all spatter is retained in a horseshoe guard provided for that purpose, and operators become so skilled in judging the quantity of metal required for a given casting that very little excess metal is poured. In 5 to 30 secs. the casting is solid, and the machine is stopped, the faceplate and pouring trough are then removed, and the plunger is operated partly to eject the casting, and then it is drawn back. The operator then places the casting with tongs, while still at 600 to 800 deg. C., in a special cooling chamber and returns to his machine. Here he blows out the mould, cleans the pouring trough of any droplets, and assembles his machine for another casting. The average time between casts varies from two to five minutes each, depending on the heat dissipation of the mould. If the mould liner is above 500 to 600 deg. C. before casting, blowholes may result in the casting or the casting may weld to the liner, and the mould assembly is often designed for rapid and even air-cooling or water-cooling, depending on the mass of hot metal handled.

Quality of Spun Castings

These machine-made castings have dimensional tolerances of *a few thousandths of an inch*, are quite grey and machinable as cast, no runners or risers are to be removed, only a slight burr at the overflow end is fettled, and one machine can turn out 175 castings per 8½-hr. day. Batteries of machines are often fed from one cupola or electric furnace, and very careful melting control is necessary for taps at 3-min. intervals. The quality of the castings is superlative; a cast iron, which in a sand casting would give 18 tons per sq. in. tensile, will, when centrifugally-cast give at least 21 tons, with a similarly improved soundness, evenness of cross-section, transverse strength, etc. All types of alloys can be made, and the writer has personally tested castings up to 32 tons per sq. in. as cast. Some castings are heat-treated up to 40 tons per sq. in. Many refinements of particular interest in regard to cylinder iron are brought about by centrifugal casting; one of these is the splitting of the phosphide eutectic into a fine hard-wearing network.

Other interesting phenomena as to physical and chemical testing, new material, cupola control, wear-resistance, etc., relating to the centrifugal casting process cannot be detailed in a Paper of this length.

Mould Material

For small air-cooled moulds for liners, piston rings, etc., cast-iron mould liners are used. A good grade of heat-resisting iron is used; they are cast centrifugally, annealed, machined to interference fit and pressed into the cast-iron mould shell. Then they are jig-bored with a slight taper, to suit the outside dimensions of one size casting. In use, the mould liner is subjected to severe alternate heating and cooling and abrasion from the casting during ejection. This results in surface mechanical wear and cracking. After making say 1,000 castings, the mould is re-bored to make a larger casting, and so on, until it is too thin, when the liner is removed and a new one fitted. Thus the life of a mould liner runs into many thousands of castings, and mould cost is therefore minimised. Front plates and plungers are similarly treated to obtain maximum life.

One of the bugbears of centrifugal casting is the "warming-up period," for, before the mould at the commencement of a cast warms up, three or four castings may be chilled and scrapped. Another difficulty is mould changing—it is not economical, or, rather, costs go up if only a few "castings off" are required. However, these matters are well looked after by the manufacturers, and these centrifugal castings can rightly be described as occupying the very forefront of the field in high-duty cast irons.

The limits imposed by the nature of the Paper prevent more details being given on the types of centrifugally-cast iron alloys, heat-treatment,

(*Concluded on page* 318.)

* Short Paper read to the East Anglian Section of the Institute of British Foundrymen.

New Cupola for Producing Controlled Carbon Content*

By MARIO OLIVO (Milan)

The principal theme of this Paper is a new method of melting in the cupola, whereby it is possible to produce iron having a carbon content within the limits of 2 to 3.6 per cent. The first part of the Paper gives diagrams representing different furnace runs and the operation of normal cupolas; in the second part a review is given of the most recent processes of heating the blast and recovering the heat in the cupola, whilst in the third part, a new type hot-blast cupola is dealt with for producing iron of controllable carbon content.

Results of Different Experimental Runs in the Same Cupola

It is very important that the samples and illustrations of the test melts, which are detailed, all relate to *the same cupola*, and that

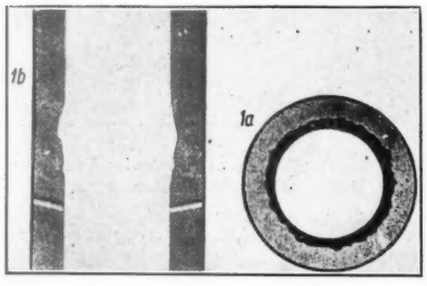


Fig. 1.—Normal Working Conditions; State of Refractory.

the melts have been conducted with the same quality of refractory lining and the same quality of coke, and the duration of melting has remained always practically the same.

In the experiments, only the volume and pressure of the blast have been varied. In some melts, the height of the tuyeres above the hearth, their reciprocal positions, and in one case also their dimensions have been varied, with a view to ascertaining the different influences which a variation of the blast and of the position and dimensions of the tuyeres may exert in the same cupola. It is believed that it is the first time that experiments and systematic checks have been conducted on the method adopted, and the following illustrated account is quite original.

The two groups of illustrations show:—(1) The state of the melting zone in consequence of the variation of the above-mentioned factors, (2) the influence exerted on the operation of the cupola in consequence of the variation of several factors.

It is regrettable that it is not possible to deal adequately, in the scope of this article,

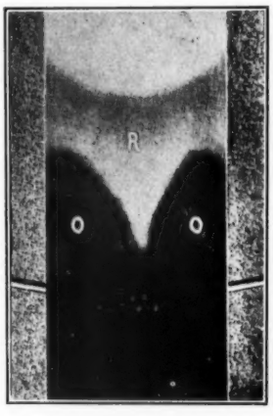


Fig. 2.—Normal Working.

with all the features which the subject is capable of offering, such as the composition of the charges, analyses, physical and chemical data, and also the metallurgical values of the various melts.

In the tests and checks, the form of the melting zone in the different runs has been specially studied. These investigations are very interesting and have made it possible to ascertain a large number of irregularities in the different runs of the cupola, and the results have furnished valuable information.

Fig. 1 shows the cross-section and longitudinal section of a normal cupola with only one row of tuyeres, after a run of three hours with normal blast conditions, that is to say, 16 in. of pressure, with an internal diameter of 26 in. and a volume of blast corresponding to 10 cubic metres per kilogram of coke charged. It will be readily seen that the lining in the melting zone has been only very slightly affected (1*a*) and that the height of the melting zone above the tuyeres (1*b*) is normal.

Fig. 2 shows the probable working conditions of this melt, in which the position of the oxidising zone (O) is situated around the row of tuyeres and extends upwardly, while the reducing zone (R) extends in conical form in the centre of the oxidising zone. This illustration, therefore, represents the normal run obtained with this melt, and this is confirmed by the structure of the castings, with an almost uniform and rather close grain.

Fig. 3 shows the effect on the refractory when, *in the same cupola*, the same conditions are maintained, except the volume of the blast, which is increased to 16 cubic metres per kilogram of coke, and the pressure, which is increased to 24 in. instead of 16 in.

The very considerable and irregular wear of the refractory in the melting zone, which in comparison with the previous illustration (Fig. 1) is much wider and extends upwardly some-

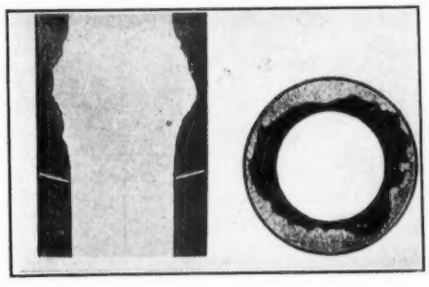


Fig. 3.—State of Refractory under Same Conditions but with Increased Volume and Pressure of the Blast.

what, is clearly visible. This appearance of the interior indicates oxidising conditions, as illustrated in Fig. 4, which shows the appearance of the different zones when the furnace is operated under these conditions. As will be seen, the oxidising zone (O) has travelled upwards, while the reducing zone (R) has been

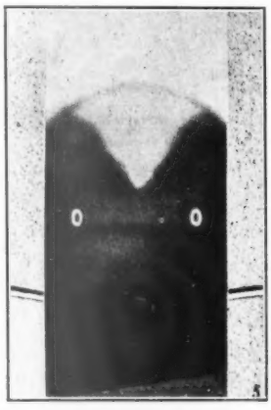


Fig. 4.—Oxidising Conditions.

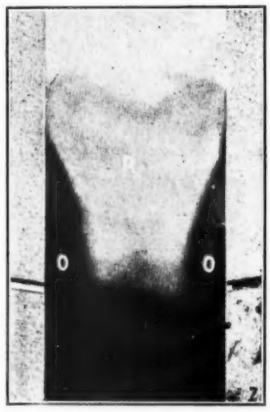


Fig. 5.—Slow Rate of Working; Reducing Conditions.

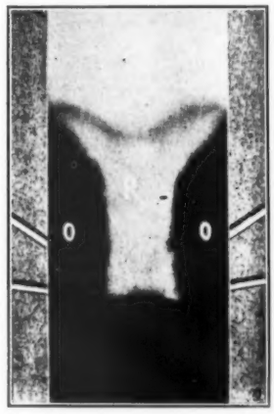


Fig. 6.—Slow Rate of Working with Two Rows of Tuyeres.

appreciably shortened and its characteristic cone has become noticeably small. The structure of the cast iron produced at this stage of the experiments showed blowholes, whilst the grain was irregular.

In order to ascertain the effect of a slow rate of working, a third experiment was made in which the pressure of the blast was reduced to

* Slightly abridged translation of a Paper given to the Polish International Foundry Congress.

12 in. and the volume to 7 cubic metres per kilogram of coke. In this case (Fig. 5) it will be seen that the oxidising zone (O) has become very small, being situated around the tuyeres, and that the reducing zone (R), on the contrary, has extended at the expense of the oxidising zone and has penetrated to the lower region of the furnace. This slow rate of working gives a coarse-grained structure which, however, has a certain regularity.

In order to ascertain the effect of a slow rate of working in the same cupola but with two rows of tuyeres, a melt was made under the same conditions as the preceding melt. The blast pressure was 12 in. and the volume 7 cubic metres per kilogram of coke. The structure of the cast iron produced was irregular but denser, and in this case the working conditions, like the previous conditions, were mainly reducing (R) with an oxidising zone (O) confined to the

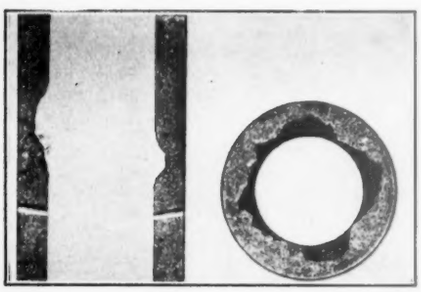


Fig. 7.—Two Melting Zones due to Irregularly-placed Tuyeres and Increased Sections.

region around the two rows of tuyeres (Fig. 6). When the results of a slow rate of working with one or two rows of tuyeres had been obtained in the same cupola, the experiments on the irregular conditions due to the excess of blast and to the irregularity of the dimensions and position of the tuyeres were resumed.

In the next experiment only one row of tuyeres was employed, but the cross-sections were increased and the tuyeres were irregularly positioned. In addition, the blast was forced by

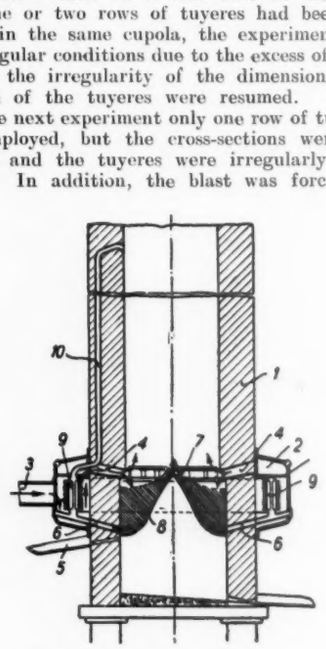


Fig. 10.—German Hot-Blast Device.

raising the pressure to 28 in. and the volume to 18 cubic metres per kilogram of coke. After the run, it was found that the refractory had deteriorated considerably and that two distinct melting zones had been formed, as is shown in Fig. 7.

The influence which a melting zone under such conditions of blast exerts on the properties of the cast iron is that the castings appear to be seriously contaminated by oxidation, as a white structure makes its appearance and there are gaseous inclusions. In the same cupola, however, with two irregular rows of tuyeres and with a pressure of 32 in. and more than 20 cubic metres of blast per kilogram of coke, the effects are still more disastrous, as will be seen from the state of the melting zone (Fig. 8), whilst the structure of the cast iron was equally bad.

Hot-Blast Cupola Operation

The series of illustrations given in the foregoing could be continued, but the author is persuaded that they are more than sufficient to

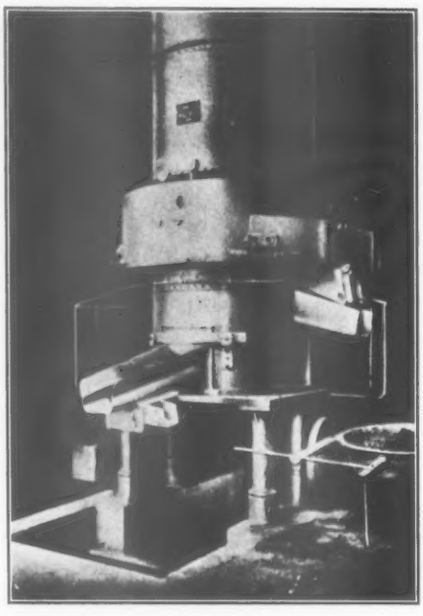


Fig. 9.—Hot-Blast Cupola.

demonstrate clearly the considerable influence which the conditions of the blast and the position of the tuyeres exert on the operation of the cupola, and the influence that the working conditions have on the product. In consequence of these observations he became convinced that, under definite conditions, it is possible to control the final quality of the cast iron, and more particularly the final carbon content.

All foundrymen are familiar with the possibility of carburising in the cupola, within certain limits, by regulating the height from the hearth and the stay of the molten cast iron therein, but up till now almost insurmountable difficulties have been encountered in the production of cast iron having a total carbon content not exceeding 3 per cent. and a silicon content of less than 1 per cent.

Increasing the temperature of the surroundings tends to result in the reducing reaction which evolves less heat:—$CO_2 + C = 2CO$. With the object of producing high-grade cast iron, oxidation is not only very dangerous in itself, but it may also compromise the success of the melting operation.

In the case of oxidising conditions, if heavy charges of steel scrap are used there is a risk of making scrap instead of cast iron. Fuel economy must be of secondary consideration, because it is more economical to burn carbon in the form of coke than to consume silicon and manganese or even iron. The production of reducing surroundings is therefore a *sine qua non* condition.

A sure means of attaining this is to heat the blast, which has the not inconsiderable advantage that the increased temperature of the blast replaces the inevitable heat loss which the reducing reaction involves. For reasons easy to understand many inventors have taken much trouble to modify the blast conditions, and a number of them, in studying recuperation processes, have proposed the hot-blast cupola in order to increase the melting temperature in the cupola.

A personal opinion is that the re-utilisation of the hot gases at the outlet of the cupola and above the melting zone or particularly at the throat, suffers from a fundamental error, because such processes must accept a loss of heat either due to errors in the dimensions of the cupola, or to the poor conditions of operation and installation, but according to the author's point of view such loss can be obviated, because it has been shown that a well-designed and well-operated cupola *has no appreciable loss of heat at its outlet.*

The Americans, in particular, have done much work in devising a hot-blast cupola, and among others the well-known Griffin process has had important applications which have given good

Fig. 8.—Two Irregular Rows of Tuyeres; Blast considerably Increased.

results, but in general the heating apparatus and devices are too complicated and costly, as in a well-known German system.

Although very appreciable results and considerable advantages have been obtained technically with hot blast, the processes are not very serviceable on account of their complicated apparatus, which renders operation difficult, expensive and impractical.

It was necessary to find a simple system which, while eliminating the numerous heating devices

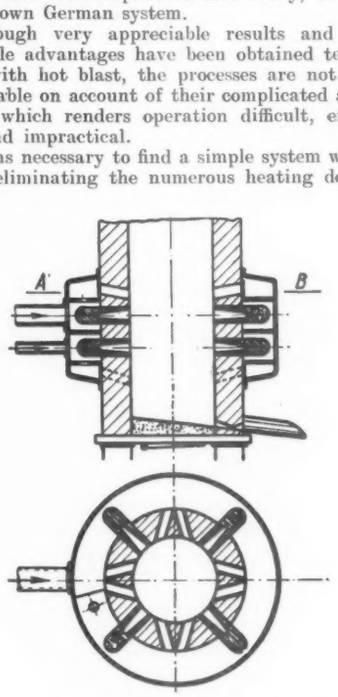


Fig. 11.—Cupola with "Heating Elements."

around the cupola, would make it possible to heat the blast by employing the internal heat, particularly in the dead zone, that is to say, from the hearth to the tuyeres, leaving all its heat in the melting zone.

In the first stage, the author discovered a solution which has given good results by collecting the gases and heat by means of a very simple device for heating the blast by employing the

gases and heat which issue from the slag notch and which are otherwise lost.

On its arrival in the wind belt, the air was mixed and heated by means of this device before entering the tuyeres. This method is shown in Fig. 9 and Fig. 10 shows another German device based on the same principle.

For two years the experiments were carried out in numerous installations in Italy with this method, and although the results obtained were very satisfactory, especially with regard to the increased melting temperature and improvement of the cast iron, the problem was not considered to have been finally solved. The author developed the principle and he succeeded in discovering such a simple and practical solution that it may be termed "Columbus' egg," as it is astonishing that no one previously had arrived at this solution, which consists in placing "heating elements" in independent wind belts.

These heating elements absorb some of the heat below the melting zone and transfer it to the blast on its arrival in a circular wind belt of special construction, and the blast, after passing once through this circular belt, enters the normal wind belt and thence passes to the tuyeres.

New Method of Cupola Melting for Producing Iron of Controlled Carbon Content

The use of heating elements made it possible to supply the cupola with blast, the temperature of which can be varied as desired from 50 to 300 deg. C. The provision of these heating elements in the independent wind belts where the blast is heated before entering the wind belts which distribute the blast among the tuyeres has made it possible to introduce at will, at different heights or zones in the cupola, the blast at the necessary temperature for obtaining well defined results, Fig. 11. With blowers provided with a suction-regulating device, the volume of the blast can be regulated independently of the pressure.

There has thus been combined all the factors which are necessary for producing in the cupola the desired conditions, *i.e.*, (*a*) different zones in the cupola and independent feeding of these zones; (*b*) regulation of the blast temperature in the different zones of the cupola, and (*c*) regulation of the volume and pressure of the blast, independently in the different zones of the cupola.

Fig. 12 shows one of these cupolas, the different wind belts and independent heating elements being clearly visible. The simplicity with which these problems have been solved and put into practice is self evident. The blast coming from the blower enters a belt A (heating) and it is heated by heating elements (A and A) situated at different levels and connected to suction pipes (a_1 and a_2). After having passed through these wind belts, the blast passes into the wind belts (B and B), where it is distributed to the different tuyeres (C) which are provided with independent regulators (c_1 and c_2) to provide the possibility of regulating the admission and distribution of the blast in the cupola. The casing (D) containing the various inner belts is adapted to be opened in sections for facilitating inspection.

Of course, the number of belts, their dimensions, the position of the heating elements, the height of the different tuyeres, and many other factors which are closely interconnected, have a primary influence on the working of the cupola. There are now a number of hot-blast cupolas which have been in operation for nearly a year. The results are very remarkable, particularly with regard to malleable cast iron. The experiments in this field are being made in a very systematic manner, but are not yet quite ready for publication.

With regard to grey iron and special iron, the three conditions of operation—oxidising, reducing and neutral as carried out in this cupola—are shown.

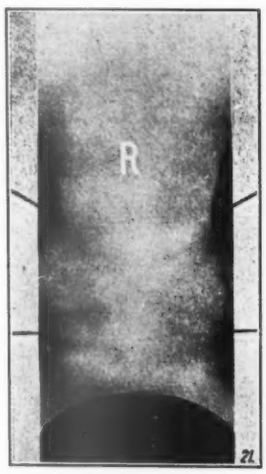


Fig. 13.—Reducing Conditions; Hot - Blast Cupola.

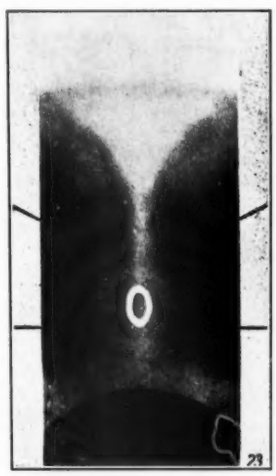


Fig. 14.—Oxidising Conditions; Hot - Blast Cupola.

Fig. 15.—Neutral Conditions; Hot - Blast Cupola.

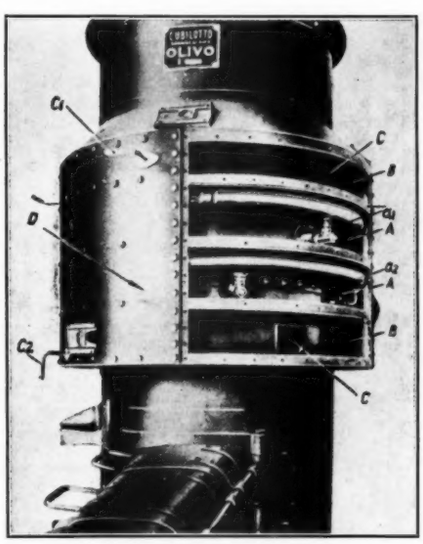


Fig. 12.—Cupola with Independent Wind Belt Heated by Heating Elements.

Reducing Conditions.—Fig. 13 shows the predominance of reduction in operating this cupola. The oxidising zone is almost non-existent. The structure of the special cast iron produced without the addition of ferro alloys is very satisfactory. The final analysis gave 2.14 per cent. total carbon and 0.11 per cent. silicon. The casting temperature was very high with this run (about 1,580 deg. C.) in order to preserve the flowing power with such low carbon and silicon contents.

Oxidising Conditions.—Fig. 14 shows the same cupola operated under oxidising conditions, produced by varying the volume, pressure and temperature of the blast in the different zones. It yielded a white cast iron.

Neutral Conditions.—Fig. 15 shows the operation of the cupola under neutral conditions employing 50 per cent. of steel scrap.

Conclusions

The possibility of being able to regulate (1) the volume of the blast independently of the pressure; (2) the introduction of the blast, the volume and pressure independently of each other in different zones of the cupola, and (3) the temperature of the blast introduced into the different zones, provides the foundryman with a number of means which heretofore have not been utilised, and which ought to make it possible to obtain from the cupola (which is still the most practical and economic means at the disposal of the foundryman) hitherto unexpected results.

Workmen's Compensation Commission

Proposals for a statutorily enforced scheme of workmen's compensation, to be linked up with the present State Health and Pensions Insurance, but which would be an employers' liability, to be covered by the affixing of another 4d. stamp on the present Health Insurance card, were submitted to the last sitting of the Royal Commission on Workmen's Compensation, at Thames House, Millbank, London, S.W.1, by the Association of Approved Societies.

The Association, which comprises 122 societies, with an aggregate membership of 1,118,018 insured persons, submitted a scheme that the responsibility for making payments of compensation should be vested in a central board especially constituted for the purpose, and operating through a competent compensation officer appointed for each defined district. A workman aggrieved by any decision of a compensation officer would be entitled to appeal to the local compensation tribunal.

The Commission adjourned to take further evidence.

Ni-Hard in the Foundry

By ARTHUR B. EVEREST, Ph.D.

One of the most interesting fields of application of Ni-Hard, the alloy white cast iron, is to be found in the foundry itself, whether producing castings in grey iron, malleable, or in non-ferrous alloys. The handling of large quantities of sand, coal and coke and of abrasives used for cleaning castings all involves substantial problems in wear and tear of plant; in fact, so severe is the wear in some parts of the equipment that daily replacement is necessary. Individual foundrymen have found innumerable applications of Ni-Hard in their own particular equipment. Some of the more generally useful of these are indicated in this article.

Sand Preparation and Handling

Many of the problems of abrasion encountered in the foundry are connected with the preparation and handling of moulding sand, these problems being in no way mitigated by the adoption of large-scale plant in connection with the modern type of mechanised foundry. The problems in this connection may be divided broadly under three heads:—(1) Sand preparation; (2) sand conveying; and (3) sand handling in connection with the actual moulding operation.

Under the first of these headings many problems arise in the ordinary types of sand mixers as employed in the average foundry. In the sand mixing and preparation plant, the grinding or mulling operation involves generally the working of the sand on a flat surface by rotating rolls or mullers. Naturally, the action of the sand on these parts leads to extremely heavy wear and abrasion on the muller tyres and pan plates, and this becomes an important factor leading frequently to inefficiency in the equipment. For this reason Ni-Hard is frequently adopted for the actual muller wheel or tyre, and also for the bottom plates or wear plates in the mill.

The life of a muller wheel is, however, relatively long compared with certain other parts of the sand mill, and especially as compared with the ploughs used for directing and turning over the sand on the pan bottom. In one case it was reported that a new mill was supplied with special steel ploughs, and after two weeks' operation these ploughs were worn out and were useless for further service. Some makers advocate that the ploughs originally supplied with the new mill should be used only as patterns in the foundry, and that castings should be prepared from the ordinary run of iron poured, thus minimising supply costs. This, however, does not minimise labour costs in changing the ploughs as they rapidly wear out, and a great deal is to be said, therefore, for the policy of using a better material which can be fitted in the mill and forgotten for a lengthy period of time.

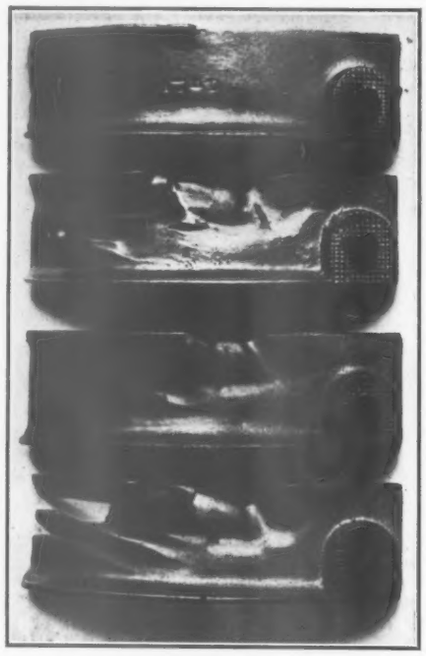


Fig. 1.—Shot-Impeller Blades after Use in Airless Cleaning Machine.

From top to bottom:—(1) Ni-Hard after 5½ hrs. (2) Ni-Hard after 81 hrs. (3) White Iron after 5½ hrs. (4) White Iron after 23 hrs.

In the case of the new mill supplied with steel ploughs mentioned above, after the failure of the steel after two weeks' service, Ni-Hard ploughs were fitted and were reported as giving efficient and satisfactory service after six months in use. The application of Ni-Hard for sand ploughs is of special importance in connection with many types of modern high-speed mills, since in such equipment efficiency depends on the correct action of each individual part, and this efficiency is lost if serious wear takes place.

A particularly interesting application of Ni-Hard in a sand mill is in connection with a special type of mill developed in the U.S.A. under the name of "Speedmuller." In this plant the actual working of the sand is effected by means of rubber-coated balls, which are carried around in a bowl-shaped receptacle holding the sand to be treated. The mill is equipped with two outside and two inside ploughs, and these move the sand in all directions, aerating it and delivering it in the muller track. High efficiency is claimed for this type of mill, and in order to ensure regular and efficient operation the actual bowl-shaped container is made from segments in Ni-Hard.

After the preparation of the sand, it is conveyed to the different points in the foundry for use in moulding machines or on the foundry floor. This often involves the use of elevators and conveyors of different types for the handling and delivery of the sand. Many types of conveyors are in use, some of them involving greater wear and tear on the constituent parts than others. Ni-Hard has many applications in these conveyors as in the same way it has many similar applications in conveyors of other types in the foundry where abrasion by sand and dust is likely to take place. For example, in conveyor plates on flight conveyors Ni-Hard has been successfully used to withstand wear and tear, as also in deflector plates for removing the sand from the conveyors at given points. Screw conveyors for collecting sand have also been made in Ni-Hard.

In the case of conveyors of other types for use in the foundry, Ni-Hard has been adopted for sprockets and skidder bars, whilst in connection with conveyors, as in other parts of foundry equipment, Ni-Hard can be used for gears and

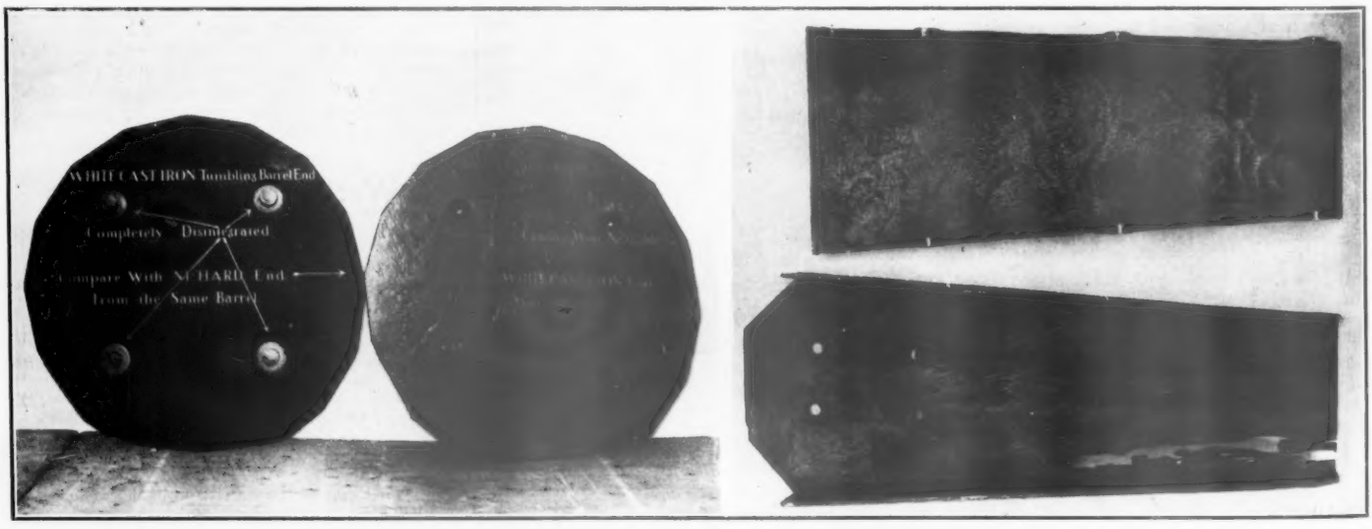


Fig. 2.—Tumbler Barrel Ends. On right is Ni-Hard End; on left are Remains of a White Cast-Iron End after Same Length of Service.

Fig. 3.—Fan Blades for Handling Pulverised Coal after 11,000 hrs. Run, Top Blade being in Ni-Hard, and Bottom Blade in High-Carbon Steel.

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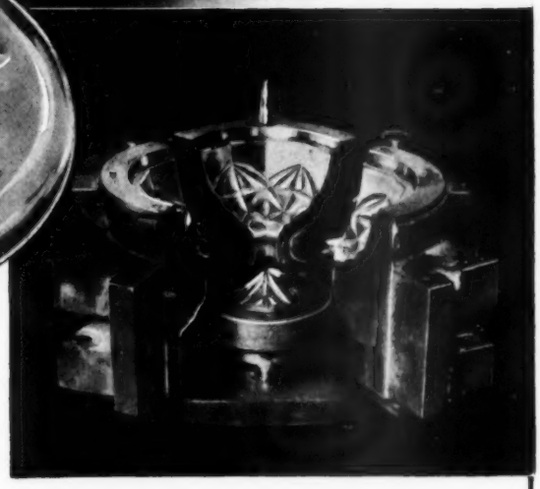

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other details exposed to rough usage and to abrasion by sand or dust.

With regard to the use of the sand in moulding equipment, one of the most interesting applications of Ni-Hard is for the cups used in the Sandslinger heads. These cups, rotating at high speed and projecting a constant stream of sand, are subject naturally to extreme wear, and the life of a cup is generally only about a day, at the end of which time efficiency has already been lost, due to the wear which has taken place. This has proved a successful application for Ni-Hard, as a result of which it is possible to run the equipment for a week instead of a day without replacing the slinger cups.

In the core shop, too, applications for Ni-Hard are found as, for example, in plates and arms and other parts of core-sand mixers, whilst an application of special interest is found in feed worms for automatic core-making machines.

Fettling Shop Applications of Ni-Hard

Whilst the problems encountered in preparing and handling sand in the foundry involve severe wear on many parts of the equipment, the question of abrasive wear is perhaps even more severe in the fettling shop, since naturally the handling of materials used for cleaning castings involves extremely severe conditions.

One of the most usual methods of cleaning castings is by means of shot blast, the stream of shot being carried by compressed air and directed by nozzles on to the castings for cleaning. The wear and tear on these nozzles is so severe that unquestionably the best service is given by some of the more expensive complex materials produced, for example, from sintered metallic carbides. For the nozzles white iron itself barely gives a useful life. It has been found, however, that where something cheaper than the expensive carbide nozzles is required, then Ni-Hard offers a useful life at only a small fraction of the cost of the former.

Sometimes the carbide type of nozzle is supported by a white-iron holder, in which case the latter generally suffers severely from wear and is relatively short-lived. One manufacturer, therefore, advocates the use of Ni-Hard for the actual holder of the special nozzle.

Certain types of shot-blast machines are equipped with rotating tables. One large firm experiencing a great deal of trouble with the wear on the table grids replaced the white-iron castings previously used by Ni-Hard. Reports after an extended experience with this type of equipment show that on a machine recently inspected, Ni-Hard grids which had been in service for four years have lost only $\frac{1}{8}$ in. in thickness, whereas the plain chilled iron last regularly only one month before being worn out in places, and thus being rendered unfit for service.

Shot-Slinging Machines

Modern practice in connection with fettling, particularly of mass-produced castings, is to use various types of shot or abrasive slinging machines. In such machines a stream of shot is fed from a hopper through a delivery tube on to a wheel fitted with blades and rotating at high speed. The shot is thrown off these blades at high velocity, and being projected on to the casting effectively cleans it and removes sand and other material. As in the case of the Sandslinger cups, the action here is one leading to extreme abrasion on the blades.

A great deal of attention has been given to the development of special compositions of cast iron suitable for withstanding this extremely arduous service. It is found, in this case, that Ni-Hard gives a useful and economic life, this being anything from 4 to 10 times that obtained with the plain iron, at of course only a relatively small increase in cost. Fig. 1 shows blades after comparative tests, and indicates clearly the superior life obtained with Ni-Hard.

Similar conditions are obtained on baffle plates and other parts of the shot-slinging equipment, and Ni-Hard has in this case similarly proved effective in increasing service between replacements and adding efficiency.

Tumbling Barrels

A third direction in which Ni-Hard has proved of interest in the fettling shop is in connection with deflectors and end plates for use in tumbling barrels. In one case it is reported that a Ni-Hard end plate was examined after 14 weeks' service, and showed no sign of wear whatever, whereas a plain chilled iron, as previously used, was worn out regularly after five weeks. A somewhat similar case is shown in Fig. 2. Plain iron is represented on the left of the picture, which shows that nothing remains of the original white cast iron end except the four bosses around the holding bolts. The plate on the right has already handled 1,000 tons of castings, and is still in relatively good condition.

Handling Coal and Coke

Whilst sand and abrasives are the materials most frequently giving trouble with wear in the foundry, reference must also be made to coal and coke, since in many types of plant these materials are handled on such a scale that they introduce problems of their own, especially where furnace firing is effected by means of pulverised fuel.

In the first place, for handling coal and coke, chutes of different types are frequently employed leading, perhaps, to conveyors. Ni-Hard has been used extensively for chute plates, where it gives many times the life of steel or plain iron. The principal application of Ni-Hard, however, in this equipment is in the plant for pulverising and handling pulverised coal.

A recent article in the "Nickel Bulletin" (February, 1938) has dealt with the use of Ni-Hard in the Herbert "Atritor." In this, as in other types of coal pulverising plants, Ni-Hard is used for the pulverising plates. In other types of pulverisers Ni-Hard has been used, for example, for the liners and balls in ball mills and for the hammers and rolls for pulverisers working on different principles.

Severe wear occurs in other parts of the equipment handling pulverised coal; for example, in the fan blades used for projecting and blowing the coal through the ring mains. Fig. 3 shows an interesting comparison between fan blades after something over 10,000 hours' life, the lower one being in high carbon steel and the upper in Ni-Hard. In other systems of handling pulverised fuel, conveyors of different types are used, including feed screws, and, as mentioned before, Ni-Hard is useful in combating wear and tear in this type of equipment.

Conclusion

The white alloyed cast iron Ni-Hard can be produced in the form of castings of all types for meeting abrasive conditions. Another development of interest, however, in connection with foundry equipment is found in the use of Ni-Hard as a hard facing or surfacing material, applied by welding, to build up an abrasion-resistant surface on the face or edge of vital parts of the equipment. This has been applied even for facing or applying a tip to feed worms, and although only in its infancy at the present time, it is possible that this method of meeting the abrasion problem as found in the foundry and elsewhere may prove of commercial interest.

As emphasised above, the very nature of the materials handled in a foundry leads to excessive wear and tear on plant. Wherever such wear is taking place, it is generally worth considering whether the reduction in replacement costs, and especially in labour costs and shut-down expenses, may not be worth minimising by the use of better wear-resistant materials such as Ni-Hard, which, after all, is not initially a great deal more expensive than the common materials generally used, and which almost invariably shows impressive economies early in its life, far outweighing the extra expense of the alloy addition.

Protection Against Eye Accidents

The Factory Department of the Home Office has issued Form 1987,* "Protection Against Eye Accidents," from which we give the following extracts:

Fixed Screens.—Wherever possible fixed screens should be used to protect the operator, both on account of their permanency and because their use involves little trouble and no discomfort. The screens may be fitted to the machine itself or on a stand between the job and the operator as near as possible to the source of danger. They should be securely fixed, of adequate strength and size, and readily adjustable. They may be of wood or metal; or, where it is important to avoid interference with visibility or lighting, safety glass, non-flam celluloid or fine wire mesh may be used. Examples of their use are:—glass, celluloid or wire-mesh screens fitted at lathes during turning operations; glass or celluloid screens fitted above tool rests at abrasive wheels (often the most convenient method of protection where the work is intermittent); and metal chip deflectors at wood-working machines.

A very important use of fixed screens is to protect adjacent workers who may be exposed to danger. Thus, wired glass screens may be fitted along the centre of a bench where chipping is done on both sides of the bench; loosely hung hessian screens may be used where trimming operations are carried on, and form an effective barrier to flying fragments on account of their damping effect; and opaque screens (*e.g.*, canvas) should be provided round welding positions to protect adjacent workers from glare.

Face Masks.—Face masks of light weight, which may be easily raised when not needed, are obtainable. They are usually less irksome to wear than goggles as they allow free circulation of air and wide vision. They might with advantage be used more widely, but they do not afford full and adequate protection in all cases.

Goggles.—Many types of goggles are now available for industrial use. Care should be taken to choose from amongst them the type which is the most suitable and efficient for the process for which they are needed. Another consideration, and one which is scarcely less important, is that they should be comfortable. They should be light to wear, and should have as wide a vision as possible and a frame that does not irritate the skin. They should also be a good fit, and goggles can be obtained which incorporate simple means for adjusting the distance between the lenses. Where subject to the risk of fracture from flying fragments, any glass used in goggles or other protective devices should be of safety type. For protection against flying fragments a light spectacle goggle with large lenses with or without side shields is available. It is comfortable and by no means unsightly, and can be fitted with non-flam celluloid or with safety type glass. Celluloid is less likely to become fogged than glass and is cheap, but it is easily scratched. Safety glass is slightly heavier, but it does not scratch. To suit defective eyesight, lenses of safety glass can be ground or, alternatively, goggles which can be worn over ordinary spectacles are obtainable. If side shields are provided they should be made of some durable material such as glass, non-flam celluloid, metal or wire mesh, and should wherever possible be provided with suitable ventilation openings. Goggles for handling acids, caustics, etc., should be fitted with soft pliable rubber to conform to the configuration of the face. It should not be possible for splashes of liquid to enter the eyes through openings provided for ventilation. For protection against fumes or fine dust, goggles of a totally enclosed type should be worn.

Numerous types of goggles and other forms of eye protection are exhibited at the Home Office Industrial Museum, Horseferry Road, London, S.W.1.

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A Battery of six in full blast.

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Head Office and Works—

Kelvinvale Mills, Maryhill, GLASGOW.

Branches at

FALKIRK, CHESTERFIELD, DEEPFIELDS AND MIDDLESBROUGH.

LONDON OFFICE: SENTINEL HOUSE, SOUTHAMPTON ROW, W.C.1.

The Week's News in Brief

Trade Talk

Federated Foundries, Limited, have removed from 105, St. Vincent Street, to 75, Hawthorn Street, Glasgow, N.

Plans for the renewal of the roof of the moulding shop at the Falkirk Iron Works were passed at a recent sitting of the Falkirk Dean of Guild Court. It was intimated that the cost would be in the region of £6,000.

It is announced that the purchasers of the Gaiety Theatre, London, the sale of which was made known recently, are Crompton, Parkinson, Limited, the manufacturers of electrical equipment. The new owners will build a block of offices.

The address of the Meehanite Metal Corporation is now 311, Ross Street, Pittsburgh, Pa., U.S.A. This company should not be confused with the International Meehanite Metal Company, Limited, of Victoria Street, London, S.W.1, which is associated with it.

Caledon Shipbuilding & Engineering Company, Limited, Dundee, have received an order for three steamers of 9,250 tons from Watts, Watts & Company, Limited, London. The machinery will be supplied by the North-Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne.

Mr. J. B. Greaves, H.M. Trade Commissioner at Toronto, will be at the Department of Overseas Trade on Tuesday to Friday, April 25-28, inclusive, for the purpose of interviewing manufacturers and merchants interested in the export of United Kingdom goods to Canada. Subsequently Mr. Greaves will undertake a tour of some of the principal industrial centres in the provinces.

It is announced that contracts have been entered for the purchase by Mr. T. H. Pailor, of Hartlepool, of J. J. Hardy & Sons, Limited, the Hartlepool brass founders, finishers and engineers, a firm which has been established for over 100 years. Mr. Pailor, who has a number of business interests at the Hartlepools, will have as his co-director, Mr. Sydney Pearson, contractor, of West Hartlepool.

Cameron & Roberton, Limited, of Southbank Ironworks, Kirkintilloch, have presented a further series of medals to employees with more than 50 years' service to their credit. Two of the directors, Mr. T. P. Cameron and Mr. James Clark, were included in the number, others being Messrs. George Peter, John Hardie, John Leggatt, James Duncan, Robert Reid, James Blair, and Andrew Bell.

Centrifugal Castings

(*Concluded from page* 310.)

autographic testing, routine records, cupola control, wear results, mould doping, and many other phases of this branch of foundry work, but if interest has been aroused the author would be very pleased to give fuller information at some future date.

DISCUSSION

Mr. C. H. Kain said that the Paper possessed general interest in that many alloys were now cast centrifugally, including steel. The centrifugal casting was not suitable to apply in an ordinary foundry—a separate building being preferable. The centrifugal force acted tangentially to the surface and not at right angles to the axis of rotation, as stated. It was a function of speed measured as surface feet. Irons cast centrifugally should be free from gases, and he asked how they compared with ordinary cast irons for specific gravity.

Mr. Parkes said that, for a given chemical analysis and cross-sectional area, an iron cast centrifugally was definitely of higher specific gravity than the sand-cast material. The phosphide eutectic together with sulphides of manganese and iron tended to find their way to the inner surface because they were the lightest constituents. Hence they were to a large degree removed when the skin was machined. This, together with the uniformity of carbon distribution, accounted for the high strength of centrifugally-cast iron.

The twenty-eighth Annual May Lecture of the Institute of Metals will be delivered by Dr. Olaf Bloch (chief chemist of Ilford, Limited), whose subject will be "The Photographic Emulsion and Its Contribution to Science and Industry." The lecture will be given on May 10, at 8 p.m., in the Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. Tickets of admission can be obtained from Mr. G. Shaw Scott, 4, Grosvenor Gardens, London, S.W.1.

A social centre for workers at G. & J. Weir, Limited, of Cathcart, was inspected recently by the Lord Provost of Glasgow. The centre includes dining rooms, library, recreation rooms, gymnasium and class rooms for apprentices. Membership of the centre is open to all workers. The firm is sending a letter to the parents of lads wishing to become apprentices, stating the terms and conditions of their employment. The rates for apprentices vary from 11s. 6d. a week in the first year to 31s. in the fifth year, plus a bonus of 2s. 6d. a week as an efficiency award. The Lord Provost described the social centre as the best of its kind in Scotland.

Orders for 13 ships have been placed on the North-East Coast. John Readhead & Sons, Limited, South Shields, are to build two 10,000-ton cargo vessels for Frank C. Strick & Company, Limited, London. Short Bros., Limited, Sunderland, whose yard has been without work for some months, are to build four vessels, three of which will be engined by George Clark (1936), Limited, Sunderland, and the other by Wm. Doxford & Sons, Limited, Sunderland. The latter firm has also secured an order from London owners for a 9,200-tons motorship. William Gray & Company, Limited, West Hartlepool, have secured contracts for six vessels.

Personal

Mr. Norman Winter, a director of Spermolin, Limited, has been appointed to serve on the Commission of the Peace for the County Borough of Halifax.

Mr. L. F. Wright, of Gjers, Mills & Company, Limited, Middlesbrough, has been nominated President-elect of the Cleveland Institution of Engineers.

Mr. E. Bruce Ball, managing director of Glenfield & Kennedy, Limited, Kilmarnock, has been elected President of the Institution of Mechanical Engineers for 1939-40.

Mr. Marcus MacDonald has been appointed electrical assistant to the chief mechanical engineer of the Great Western Railway Company at Swindon, in succession to Mr. J. R. W. Grainge, retired.

Mr. J. H. W. Pawlyn has been elected chairman of Ransomes, Sims & Jefferies, Limited, in place of the late Mr. E. C. Ransome. Mr. L. C. Horsley, secretary of the company, has been elected a director.

Mr. Wilfred Ayre, chairman and managing director of Burntisland Shipbuilding Company, Limited, has been elected President of the Institution of Engineers and Shipbuilders in Scotland.

Mr. J. A. Roper, chief engineer of Platt Bros. & Company, Limited, Oldham, has been appointed a director of Brooks & Doxey, Limited, Manchester, a constituent company of Textile Machinery Makers, Limited. To mark the occasion, the foremen and staff of the maintenance department of Platt Bros. have presented Mr. Roper with a gold wristlet-watch and a case of pipes.

Obituary

Mr. G. Rashleigh, travelling representative of Warner & Company, Limited, manufacturers of special pig-irons, of Cargo Fleet, Middlesbrough, died suddenly at his home near Manchester on March 25.

Mr. William Mason, who died last Sunday while on a visit to Llandudno, was the founder of a successful malleable foundry at Walsall. In 1912 he went into partnership with Mr. J. F. Burns and established the firm of Mason & Burns, which in 1936 was converted into a public limited company. This firm was one of the first to install a rotary pulverised fuel-fired melting furnace. Mr. Mason, who became chairman, was contemplating retiring.

Contracts Open

Dublin.—Supply and erection of a 30-ton weighbridge, for the Alliance & Dublin Consumers' Gas Company. Mr. H. Dumbleton, chief engineer, Gasworks, 110, Pearse Street, Dublin.

Mansfield, May 6.—Supply, erection and setting to work of complete equipment of an electrical sewage pumping installation with vertical spindle centrifugal sewage pump and motor in duplicate, for the Blackwell Rural District Council. Mr. Austin H. Elliott, engineer, Gilcroft Chambers, Church Lane, Mansfield. (Fee £2 2s., returnable.)

Portsmouth, April 26.—New pumps, motors, starters, switchgear, rising mains, etc., and the dismantling of the existing apparatus, for the City Council. The City Engineer, Guildhall, Portsmouth. (Fee £1 1s., returnable.)

Wayland, April 27.—43 miles of 3-in., 4-in., 5-in., 6-in., and 7-in. pipes and cast-iron flanged pipes and special castings, for the Rural District Council. Mr. A. J. Martin, 106, St. George's Square, Westminster, London, S.W.1. (Fee £3 3s., returnable.)

Company Reports

British Timken, Limited.—Dividend for 1938 of 15 per cent.

Heenan & Froude, Limited.—Interim dividend of 5 per cent.

Lancashire Steel Corporation, Limited.—Half-yearly dividend on the 5 per cent. cumulative redeemable first preference shares for the six months to April 30.

R. W. Crabtree & Sons, Limited.—Net profit for 1938, £72,450; dividends of 12½ per cent. on the preferred ordinary shares and 40 per cent. on the ordinary shares. In addition, the directors propose to capitalise £120,000 of the reserve and to distribute a bonus of four new ordinary shares in respect of each ordinary share now held.

Manganese Bronze & Brass Company, Limited.—Net profit for 1938, after charging depreciation and £4,600 for N.D.C., £83,188; brought in, £21,746; general reserve, £20,000; contingencies reserve, £4,000; reserve for income tax, £14,000; dividend on "A" preference shares, £4,556; final dividend on the ordinary shares of 6d. per share (making 9d. per share for the year); carried forward, £25,588.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

W. H. Paul, Limited.—Capital, £2,000. Ironfounders, etc. Directors: W. H. Paul, 182, Brookhill Street, Stapleford, Notts; J. Drew.

Kent Alloys, Limited, 41, Whitehall, London, S.W.—Capital, £100,000. Engineers, founders, etc. Directors: H. O. Short, A. Gouge and J. H. Wood.

Chambers & Company (Bury), Limited.—Capital, £1,500. Engineers, founders, etc. Directors: E. Chambers, 76, Wellington Road, Bury; E. Chambers, jnr., and H. Chambers.

H. J. Horswell & Son, Limited, Tyrone, Chalfont St. Giles, Bucks.—Capital, £10,000. Engineers, boiler makers, founders, etc. Directors: H. J. Horswell, A. A. Parrott, and E. L. Lester.

Forthcoming Events

APRIL 18.

Institution of Chemical Engineers:—"Administrative Training for the Chemical Engineer." Paper by E. S. Byng, at Rooms of the Geological Society, Burlington House, Piccadilly, London, W.1, at 6 p.m.

APRIL 21.

Junior Institution of Engineers (Sheffield Section):—"The Electric Furnace—Its Application to Steelworks' Practice." Paper by H. A. Wainwright, at Metallurgical Club Rooms, 198, West Street, Sheffield, at 7.30 p.m.

Institute of British Foundrymen

APRIL 21.

Birmingham, Coventry and West Midlands Branch:—Annual general meeting, at James Watt Memorial Institute, Birmingham, at 7.30 p.m.

Middlesbrough Branch:—Visit to laboratories of Head, Wrightson & Company, Limited, Thornaby-on-Tees.

TOR ROCK SAND

for the

FOUNDRY

Higher casting temperatures in iron foundries—particularly in those where special alloys are melted—have resulted in a demand for a moulding sand to withstand severe conditions and produce sound castings of good finish. Tor Rock Sand has proved to be specially suitable for these requirements. It is coarse in grain and highly permeable and being somewhat irregularly graded, tends to give a strong and compact mould surface.

Please write for full particulars and sample:

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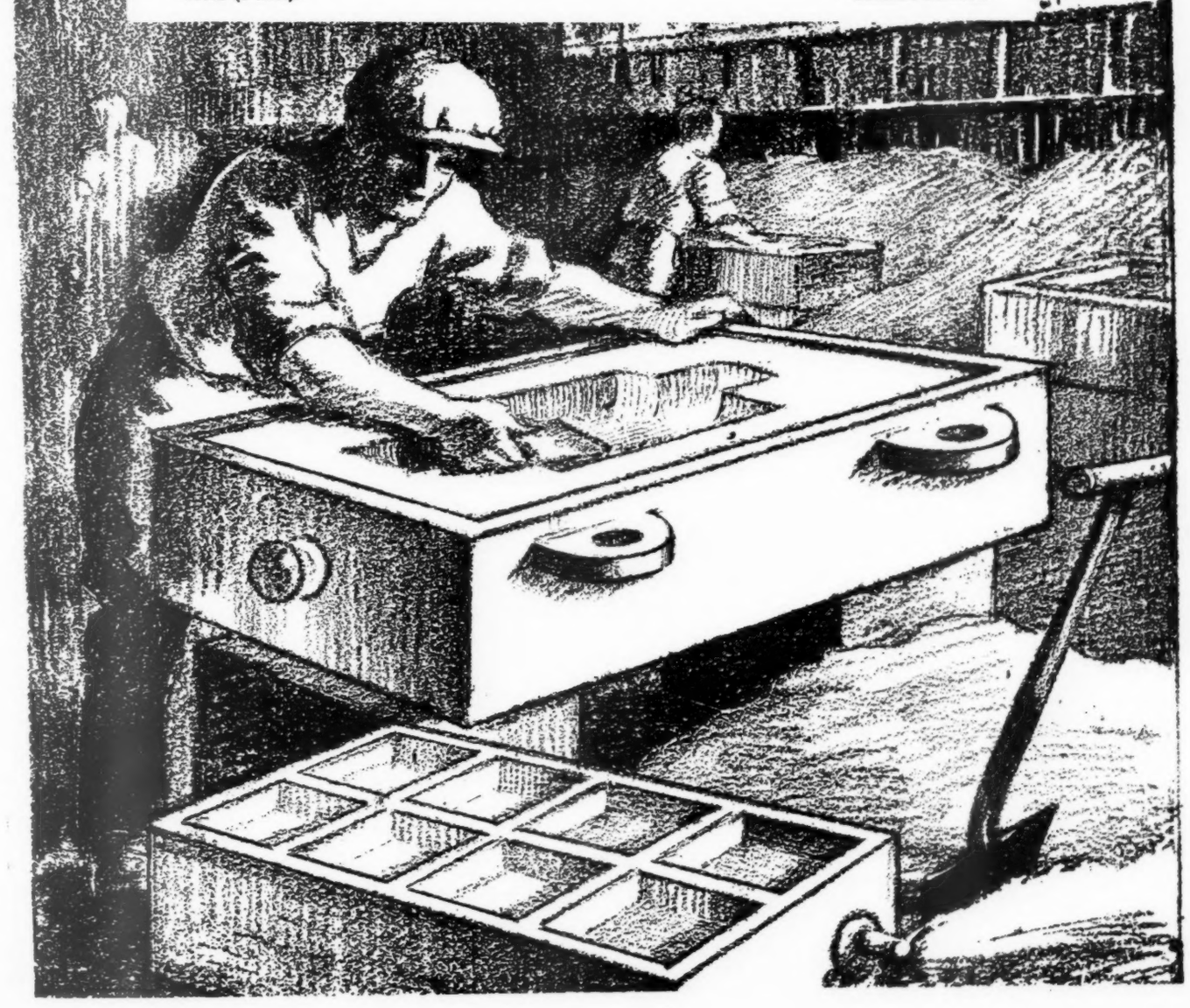
GENEFAX HOUSE, SHEFFIELD.

Telephone: 31113 (6 lines).

Telegrams: "Genefax, Sheffield."



Raw Material Markets

Owing to the incidence of the Easter holidays, business in the iron and steel markets has been very quiet during the past few days, but a revival should not long be delayed, as certain sections are becoming increasingly busy, especially those concerns engaged on rearmament work.

Pig-Iron

MIDDLESBROUGH.—Just prior to the holiday there was some improvement in the condition of the Cleveland iron market, although business in this section is still unsatisfactory. The shortage of scrap has compelled many local foundries to take up additional tonnages of iron, while deliveries to Scotland have been on a slightly better scale. The demand for basic iron continues to exceed the production; the price quoted, 92s. 6d., is purely a nominal figure. No. 3 Cleveland G.M.B. foundry iron is quoted at 99s., No. 1 foundry 102s., and No. 4 foundry and No. 4 forge 98s., all less 5s. per ton rebate.

It is satisfactory to record that stocks of hematite at many of the makers' works in this area are being reduced quite steadily. There is not much new business being done for forward dates, but prompt requirements are substantial and consumers are drawing supplies against contracts freely. Recently 1,000 tons of hematite were despatched to South Wales. It is not yet thought likely that production will be increased in the near future, as stocks are still quite heavy, but makers are hoping that by the end of the half-year it will be necessary for them to expand outputs. Prices, too, will come up for revision at that time.

LANCASHIRE.—Apart from those concerns engaged on armament work, trade in this area remains on the quiet side, with the forward outlook not too bright. It had been expected that the light-castings trade would have become more active by now, but there has been only a small expansion of business as yet, while most of the textile-machinery makers are not well placed for work. Speciality engineers are taking up heavy tonnages of iron, but most business is restricted to early deliveries. There continues to be a slightly improved demand for hematite.

MIDLANDS.—High-phosphorus iron continues to be a weak market, and business is very unsatisfactory. It should be possible to supply large tonnages of iron to the light-castings founders at this time of the year, but so far trade in this section has shown little expansion from the level of the earlier winter months. Derbyshire No. 3 foundry iron is quoted at 101s., with Northamptonshire No. 3 at 98s. 6d., both less 5s. per ton rebate and delivered Birmingham and Black Country stations. Low-phosphorus iron, on the other hand, continues to find a readier market and substantial tonnages are regularly changing hands. Owing to the fact that supplies come from various districts, prices range from a minimum of £5 5s., delivered. Competition is now being met as a result of Indian iron entering this area at prices which compare quite favourably with the cheapest English iron. Consumers of hematite are showing more interest in contracting ahead, and a number of users have covered their requirements over several months. Stocks at present are ample to meet the demand, but are being steadily reduced.

SCOTLAND.—There has recently been a sharp increase in the call for supplies of foundry iron, owing to the acute shortage of scrap, and business has shown a welcome improvement. In fact, the possibility of expanding outputs is being canvassed at many producing works. No. 3 foundry iron continues to be quoted at 105s. 6d., with No. 1 at 108s., both f.o.t. furnaces. Basic and hematite irons are being taken up by the steelworks in ever-increasing tonnages, owing to the heavier outputs of steel. Hematite mixed numbers are quoted at 120s. 6d., and basic at 92s. 6d., delivered, less 5s. rebate in each case.

Coke

Business in foundry coke continues to be on a satisfactory scale. For delivery to Birmingham and Black Country stations, the minimum price of 50s. 6d. for Durham and Welsh coke will remain in operation at least for the remainder of this quarter.

Steel

As a result of the amount of work on hand at the steelworks, production was continued in most cases over the whole of the Easter holiday. In many instances, works are fully booked up over a number of weeks ahead. The acceleration in the demand for steel for Government orders has made an enormous difference to the works, which are mostly poorly placed for orders from civil consumers. As yet, the demand for shipbuilding material has not shown much expansion, but the subsidy proposals will no doubt have a beneficial effect later. In some sections of the steel trade, where there had recently been an improvement in civil work, this work has had to be postponed owing to the inability of the steel plants to deal with Government orders as well.

Scrap

Business in the iron and steel scrap market continues to offer freely, and supplies are having to be carefully rationed. Owing to the uncertainty of future supplies, dealers are preferring to sell small parcels for early delivery rather than commit themselves ahead and then find that they are unable to meet their contracts.

Metals

Copper.—The holidays have, of course, interfered with business, and there has been little activity during the past week. The London Metal Exchange was closed from Thursday afternoon, April 6, until Tuesday morning last. Despite the lack of support, the tone of the market has been well maintained. The United States market is still quiet, and last week the American Smelting Company reduced their quotation for domestic copper by ½ cent to 10.75 cents per lb.; this move has now been followed by other producers. It is not thought in metal circles in America that this reduction will induce much more business, and it is suggested that the quotation will have to be lowered to around 10 cents per lb. before trade is likely to increase materially. Domestic copper sales during March totalled 28,678 short tons, against 20,360 tons in the previous month.

Metal Exchange quotations were as follow :—

Cash.—Wednesday, £42 5s. to £42 6s. 3d.; Thursday, £42 12s. 6d. to £42 13s. 9d.; Tuesday, £41 18s. 9d. to £42; Wednesday, £42 2s. 6d. to £42 3s. 9d.

Three Months.—Wednesday, £42 11s. 3d. to £42 12s. 6d.; Thursday, £42 18s. 9d. to £43; Tuesday, £42 5s. to £42 6s. 3d.; Wednesday, £42 8s. 9d. to £42 10s.

Tin.—There has been little change in the condition of this market during the past few days; business is still quiet, but the tone is quite strong in the circumstances. The tinplate trade continues to become more active and is now employed at around 56 per cent. of normal capacity, as compared with about 45 per cent. at the corresponding period of last year. Sales at present are considerably in excess of the production, and overseas trade has shown a welcome improvement.

Official quotations were as follow :—

Cash.—Wednesday, £214 15s. to £215; Thursday, £215 5s. to £215 10s.; Tuesday, £214 to £214 10s.; Wednesday, £215 15s. to £216.

Three Months.—Wednesday, £213 to £213 5s.; Thursday, £213 10s. to £213 15s.; Tuesday, £211 10s. to £211 15s.; Wednesday, £213 5s. to £213 10s.

Spelter.—Immediate requirements are being satisfied by consumers of this metal, but forward trade is not very brisk. Apart from sales of high-grade metal, which are quite good, trade in the United States is dull.

Daily market prices :—

Ordinary.—Wednesday, £13 1s. 3d.; Thursday, £13 10s.; Tuesday, £13 5s.; Wednesday, £13 3s. 9d.

Lead.—Although most consumers are taking up contract deliveries on quite a satisfactory scale, new business is dull.

Day-to-day quotations :—

Soft Foreign (Prompt).—Wednesday, £13 18s. 9d.; Thursday, £14 2s. 6d.; Tuesday, £14; Wednesday, £14 1s. 3d.

Scrap.—The improvement noted in this market last week has scarcely been maintained, owing to the holiday interruption, but a resumption of business should shortly materialise.

Approximate selling prices for old metal:—New aluminium cuttings, £70; rolled, £57; cast, £32 to £33; foil, £80. Copper, £39 to £44; braziery, £36. Brass (clean), £20 to £24. Zinc, £10. Lead, £13 15s. Gunmetal, £38 to £39.

Company Meetings

Hadfields, Limited

In the absence through indisposition of Sir Robert Hadfield (chairman of the company), MR. P. B. BROWN (deputy chairman) presided at the annual meeting of Hadfields, Limited, Sheffield. Mr. Brown said that trading conditions during 1938 were very unstable and perplexing. During the first eight or nine months of 1937 the demand for steel considerably exceeded the country's productive capacity. Following this, for some months their furnaces were fully occupied; then there came a rapid falling off in the demand for steel and the position became somewhat alarming in the months of June, July, August and September of 1938. Since the international crisis in September last, trading conditions had steadily improved, but they had a long way to go before their workshops became overloaded, as they were at this time last year. The demand for alloy steels for aircraft and motor transport vehicles had been maintained throughout the year, their production of electrically melted steel being greater than ever. There had also been quite an appreciable increase in their output of colliery requisites. Normally, a considerable proportion of the foundry output consisted of replacing wearing parts for crushing machinery for mines situated in various parts of the world. This section had been kept fairly busy throughout the year. Unfortunately, a number of the large and important mining companies, controlled in London and financed by British capital, continued to purchase their replace parts on the Continent, where lower prices could be quoted because of the much lower wages paid there, and in some cases due to the fact that export subsidies were paid by their Governments. He thought a more patriotic view might well be taken by those in control, especially by companies that were in a very prosperous condition. Despite the increasing calls on them in connection with the rearmament programme, the turnover of the more important and permanent part of their business, "commercial" as distinct from "ordnance," had increased year by year since the slump year of 1932, and in 1938 was the highest on record, exceeding that of 1937 by approximately 20 per cent. Their overseas trade had been steadily increasing since 1932, the increase of 1938 over that of 1937 being much greater than that of any of the other years. Last year he referred to their programme of extensions to premises and plant. Most of the items then mentioned were now completed, but their engineering department was still being taxed to its utmost capacity, as new demands were constantly being made upon it in order to cope with the ever-changing conditions. In the immediate future they intended to erect a new physical and research laboratory, which would enable the work now being done in scattered departments to be concentrated and more efficiently carried out.

Federated Foundries, Limited

The annual meeting of Federated Foundries, Limited, was held in Glasgow on March 31. MR. WILLIAM RENNIE (chairman), who presided, said that the fall in profits for 1938, as compared with 1937, must be considered by shareholders as disappointing, although, with certain outstanding exceptions, industrial profits as a whole reflected the difficult trading conditions of last year. The uncertainty of the international situation, culminating in the crisis in September, resulted in a very definite reduction in the domestic and industrial building programmes which were the main sources of their business. The rearmament programme had not to any great extent brought business to their companies. The prospect for business during the remainder of this year was obviously dependent upon international developments.

New Blast Furnace at Middlesbrough

A new blast furnace is being lighted at the Acklam works of Dorman, Long & Company, Limited, Middlesbrough. The furnace has been designed and built by the firm. Another furnace at the same works is to be blown out for re-lining.